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PRACTICAL
SURGERY

HEATH



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DICTIONARY
OF
PRACTICAL SURGERY

BY

VARIOUS BRITISH HOSPITAL SURGEONS

EDITED BY

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best to stop the bleeding by one of the plans named in Rule 2.

Rule 6.—If the injured person has to be carried far, either to a hospital or to a house, bear in mind—(a) To keep him warm with rugs or clothing. (b) To keep the limb continually raised on cushions. (c) To watch for bleeding. (d) Not to give too much brandy, especially if you have not been able to put on the tube.

Fractures may be treated by temporary splints made out of newspapers, the cushions of railway carriage-seats cut up; and straps and handkerchiefs or shirt-tails will make good bandages.

For the immediate relief of shock, avoid transportation to long distances: utilise cottages or buildings near the scene of the accident; insist on rest and quiet, and freedom from exciting interviews with friends; give diffusible stimulants or alcohol in moderation; also give hot coffee and beef-tea, when possible. For the treatment of nervous excitement after shock, bromide of potassium, in ten-grain doses, combined with the same quantity of carbonate of ammonia, may be given in an effervescent form with good effect.

Opium, chlorodyne, hydrate of chloral, &c., are usually contra-indicated, as they generally increase the nervous excitement. They should be given only in cases of severe organic injury, to relieve pain. With regard to operative measures, fractures and dislocations should be reduced at once, and, in injuries which require amputation, a primary operation is generally best. There is usually little chance of saving limbs, with comminuted and compound fractures especially, where joints are involved; and there is much risk to life in the attempt to do so. Of course, it is often necessary to wait for the first effects of shock to pass off.

The treatment of fright and emotional and functional illness is often a question of difficulty. It may be taken, as a general rule, that the less medicine given the better, and that as little fuss be made and as little anxiety shown as possible. But the surgeon is often in a dilemma. Many patients resent most vigorously any light estimation of their injuries, and any encouragement to resume work or get about is looked on as inattention or ignorance. Then, again, the friends usually interfere, and another and a more sympathetic doctor, so called, is recommended. It follows, therefore, that moral treatment is necessary. The confidence of the patient must be first gained by sympathy and attention, then he may be informed of the nature of the symptoms, and will more readily follow the necessary treatment.

The symptoms which most commonly require active treatment are dyspepsia, con-

stipation, and sleeplessness. For dyspepsia, a dinner pill containing a grain each of gray powder, euonymin, and powdered rhubarb may be given before each meal, and an effervescing saline with ammonia, after meals, is very efficacious for pain and flatulence. For constipation, by far the safest and most effectual drug is cascara sagrada. It does not debilitate nor depress the nervous system like saline aperients and mineral waters, nor is it followed by constipation, like most of the cathartics and other aperients. A very good formula is the following:—Liquid extract of cascara, ℥j.; syrup, f℥j.; maltine, f℥ij. One or two teaspoonfuls to be taken before the evening meal or at bedtime, in water. For sleeplessness, it is a very bad plan to give large doses of bromide, and as for opium, morphia, chlorodyne, and hydrate of chloral, there is no surer way of retarding recovery than to give them. As the general symptoms of shock subside, sleep will return, and good nights may often be obtained by a glass of hot whiskey and water at bedtime or hot beef-tea or gruel. Many of the symptoms of nervous shock are much aggravated by the injudicious use of strychnine and iron. It is not unusual to find that large doses have been given from the date of the accident, generally with the effect of producing palpitation, twitching of limbs, sleeplessness, sensations of pins and needles, headache, and dimness of sight, all of which symptoms are immediately attributed to the accident, and any nervous shock that may have been sustained is thereby materially increased.

In cases of persistent nervous shock, leading to hypochondriasis, hysteria, and other neurotic symptoms, such as paralysis, hyperæsthesia, or anæsthesia, change of air and scene is a good remedy; but when this is recommended, the beneficial effect that would ensue is often retarded by the anxiety and officiousness of friends or relatives who accompany the patient, and never cease to talk of the accident or to enlarge upon his injuries. Again, it is common to find the nature of the symptoms misunderstood, and often escharotic liniments, blisters, and even the actual cautery, are applied.

There can be no doubt that, in such cases, treatment at a hydropathic establishment is most advantageous. Isolation from friends, change of scene and habit, absolute regularity in diet, freedom from stimulants and narcotics, are thus ensured, while there is every convenience for sedative local treatment by shampooing, massage, douching, and compress; and, lastly and most import-

ant, the attention of a medical man understanding the moral treatment of the patient is secured. There is a certain proportion of cases, however, where nothing but money compensation will do any good. Those persons are not always dishonest—the worry of impending litigation, or anxiety about business losses, may keep up the nervous state; others, knowing that pecuniary compensation is certain to be obtained, will not make the slightest effort to return to business and shake off lethargy and laziness.

In cases of concussion of the spinal cord or brain, of course the first necessity is absolute quiet and rest in bed, and, if there is no doubt about the correctness of the diagnosis, the surgeon should insist on a much longer rest than the patient is often disposed to take.

Where there is localised tenderness of the spine, stimulating liniments and unguents (especially oleate of mercury) do good. Blisters and the actual cautery may sometimes be applied with much benefit, but in hysterical and nervous cases they are not to be recommended. Where there are symptoms of inflammatory changes taking place in the cord, iodide of potassium and bichloride of mercury in small doses are beneficial. In spinal anæmia it is found that iron, arsenic, strychnine, and quinine may be given with good effect, and, where paralysis has occurred from this cause, a course of galvanism with the slowly interrupted current should be tried. Where there are symptoms of meningeal inflammation of the brain or spinal cord, the writer has found grain doses of calomel and extract of aconite relieve pain and spasm in a marked degree. THOMAS BOND.

RANULA.—The term 'ranula' has been employed, somewhat loosely, to indicate the various sublingual cysts which project into the floor of the mouth by the frænum. Such a tumour may originate in many ways—by dilatation of one of the excretory ducts of the sub-lingual or sub-maxillary gland, by enlargement of the sub-lingual bursa of Fleischmann, or by cystic transformation of the connective-tissue interspaces of the part; or it may be dermoid or hydatid in structure. It is desirable, however, to exclude the two last, reserving the name 'ranula' for tumours having the characters about to be described, until the advance of pathology and diagnosis enables us to dispense with the expression altogether.

Symptoms.—The true ranula appears as a soft fluctuating tumour beneath the

tongue, on one or other side of the frænum, encroaching more or less upon the buccal cavity, and often projecting in a downward direction to give rise to a prominence in the sub-maxillary region. It is smooth, bluish, and translucent, of globular or ovoid form, and its surface is often traversed by Wharton's duct. The contained fluid is more or less viscous, tasteless, transparent, and of a tint varying from the palest straw to a deep brownish-yellow; and is occasionally discoloured by the admixture of blood or pus.

When small, it causes little inconvenience, but it may attain such large dimensions as to interfere with deglutition, articulation, and even with respiration. In one case mentioned by the elder Cline, the patient was on the point of suffocation in consequence of the backward displacement of the tongue by a huge ranula, when a timely use of the surgeon's lancet averted the danger. The tumour may appear at any age and in either sex, and can rarely be traced to any exciting cause.

Pathology.—It was once believed that the majority of cases of ranula were due to dilatation of a portion of Wharton's duct behind an impacted salivary calculus, but it is now certain that such a condition is very exceptional, even where a competent source of obstruction has been found; and some authorities have gone so far as to deny its existence altogether. The researches of Recklinghausen tend to show that the tumour is nearly always developed at the expense of the ducts of the sub-lingual gland, behind an inflammatory constriction or closure of the lumen of the tube. It is not, however, a mere dilatation containing an accumulation of saliva, but a true cyst, differing, both in its structural characters and the nature of its secretion, from the gland from which it is derived.

The cyst wall consists of a capsule of connective tissue with elastic fibres and vessels, usually delicate, but sometimes of considerable thickness ($\frac{1}{25}$ th of an inch), and lined with a double layer of epithelium, of which the superficial cells are cylindrical and ciliated; and chemical analysis of the fluid reveals the presence of mucus and albuminate of soda, but neither ptyalin nor sulpho-cyanide of potassium. With these peculiar features, it might be doubted whether the condition really arises in the manner described, but Recklinghausen has succeeded, in some cases, in discovering the orifice of the gland-duct in the wall of the cyst.

The share taken by Fleischmann's 'sub-lingual bursa' in the etiology of ranula is

still uncertain. This anatomical structure may be demonstrated without difficulty in many subjects, and there is no reason why, like other bursæ, it should not occasionally give rise to a cystic tumour; but it cannot be said that any ranula has ever yet been proved to originate in this manner. It is probable that, in a case of the kind, the character and composition of the fluid and the structure of the cyst-wall would be found to vary from the description just given, as that of the typical ranula.

Treatment.—As a preliminary measure, a careful search should be made, by palpation, for a calculus or other source of obstruction, which must be removed if found; but should nothing of the kind be discovered, the surgeon has the choice of several methods by which he may attack the tumour directly.

(1) Complete excision of the cyst. This method was recommended by Marchetti in the early part of the present century, and more recently by Schuli and others, but has seldom been carried into effect. It is necessarily the most radical procedure, and it is less difficult than might be anticipated, as the cyst-wall adheres but loosely to the adjacent tissues. The floor of the mouth must be fully exposed; and after freely incising the tumour in its long axis, the cyst may be removed, partly by traction, partly by small curved scissors. The administration of chloroform must usually be dispensed with, owing to the risk of entrance of blood into the air-passages.

(2) Removal of a portion of the cyst-wall with the superjacent mucous membrane. The operation rarely effects its purpose, owing to the speedy closure of the gap, and is now employed chiefly as a preliminary to other measures.

(3) The establishment of a permanent fistula to allow the continual escape of the contents of the tumour into the mouth. Louth endeavoured to achieve this end by repeated cauterisation of the edges of the opening left by an excision of a portion of the cyst, but without success. Dupuytren's *bouton à chemise*, as modified by Reisinger—a short canula with a button-like plate at either end—was an ingenious device to attain the same object. One extremity of the instrument was inserted into the cyst, the other remaining in the mouth, while the intermediate portion prevented the closure of the wound and provided an exit for the escape of the fluid. Chelius and others have expressed satisfaction at the results, but it has generally been found that the movements of the tongue rendered

it difficult to keep the implement in place. A simpler and most effectual method is the insertion of a loop of silver wire, which will lie quietly in the floor of the mouth and act as a permanent drain.

(4) The obliteration of the cyst by inflammation. For this purpose many plans have been essayed, including setons, the injection of iodine and other fluids, cauterisation of the interior of the cyst after the excision of a portion of the wall, and plugging the cavity with lint or other material, plain or steeped in iodine or chloride of zinc solution; but although a cure sometimes follows the means adopted, the general rule is failure, with the occasional addition of troublesome inflammatory complications in parts outside the limits of the tumour.

SUB-LINGUAL DERMOID CYSTS are not often met with. They may be diagnosed from true ranula by their congenital origin (of which, however, it is not always possible to obtain a history), their comparatively slow growth, their greater firmness of consistency, and, especially, by the absence of translucency. They usually tend to project chiefly in the direction of the sub-maxillary integument. The appropriate treatment is excision.

HYDATID CYSTS in the position of ranula are extremely rare. It might be difficult to distinguish their nature before operation without a microscopic examination of the contents.

SUB-LINGUAL ABSCESSSES AND HÆMATOMATA may generally be recognised without difficulty by the history of the swelling, except where the suppuration or hæmorrhage has occurred within the cavity of a ranula. In cases of doubt, the diagnosis may be established by the examination of a portion of the fluid drawn off by a small aspirator (morphia injection-syringe) or a trocar and canula. W. ANDERSON.

RAYNAUD'S DISEASE. See ARTERIES, Diseases of; GANGRENE.

REACTION.—When a patient recovers from a condition of collapse, he passes on into the state known as that of reaction. The time that elapses between the oncoming of the collapse and the commencement of reaction varies according to the amount and intensity of the former. The stages of reaction are various. In some cases, the patient will rapidly pass from one to the other, so that complete restoration of the impaired faculties is brought about in a few minutes; in other cases, reaction is

slow and improvement almost imperceptible, and complete restoration does not take place for days or weeks.

The *symptoms* of reaction are as follows:—The patient, who has been lying motionless on his back, evinces a desire to change his position; in many cases he soon begins to retch, and perhaps vomits. The pulse improves in volume, tone, and rapidity; the respirations become deeper, and are often sighing; the clammy skin becomes warmer, and the lips assume a redder hue, swallowing is more easily accomplished; the mental faculties are gradually restored, the patient takes notice of surrounding objects, and is able to answer questions rationally. In some cases, complete restoration now ensues without further complication; but in others, after some hours, feverish symptoms supervene, the skin becomes hot and dry, the face is flushed, the eyes are bright, and the mental faculties are all in a state of excitement. The pulse becomes rapid and jerky, the respirations hurried; the patient is restless, and complains of thirst and headache. The temperature also rises to a varying extent. In this condition the patient may remain for a time, varying from a few hours to one or two days. Recovery is often by crisis, and after a long sleep complete convalescence may quickly ensue. In yet other cases, however, worse symptoms may follow, and a condition of ‘prostration with excitement’ may result; the rapidity and weakness of the pulse increase, respiration becomes gasping and hurried, the tongue is dry and tremulous, the patient becomes restless, and often wildly delirious, the temperature rises, and no sleep can be obtained. Exhaustion gradually supervenes, the pulse becomes running, the delirium becomes of the low and muttering variety, and the patient dies in a state of coma.

The above symptoms may be thus explained:—In consequence of the collapse induced by the injury, there is necessity for increased action of the various vital organs in order to preserve life. But, in consequence of the weakness induced by the same injury, there is a want of power in the organs on which the call is made. If the want of power be excessive and the need of action great, there results ‘prostration with excitement;’ if power be sufficient, a reaction which soon accomplishes its purpose will ensue.

Treatment.—So long as reaction is not excessive, there is no indication for treatment. If it be excessive or prolonged unduly, the indications are—(1) to support the

patient’s strength; (2) to moderate the excessive irritability of the vital organs. With regard to the first, stimulants must be sparingly given, and reliance placed rather on strong fluid nourishment, and nutrient enemata if vomiting be troublesome. The second indication is fulfilled by perfect rest and quiet, keeping the head cool, and giving opium or morphia in doses which are sufficient to produce the required effect, but which must be regulated according to the requirements of the case. Hyoscyamus and belladonna are also useful.

ANTHONY A. BOWLBY.

RECTOCELE—Prolapse of the posterior wall of the vagina. *See* VAGINA, Affections of the.

RECTO-VAGINAL FISTULA. *See* VAGINAL FISTULÆ.

RECTO-VESICAL FISTULA. — A communication between the rectum and the bladder, with usually the result of an escape of fæces or flatus into the bladder or urethra, or of urine into the rectum.

It may be congenital, or be caused by accident, operation, or ulceration. If the rectum be imperforate at birth, this condition is sometimes complicated by an arrest of development of the perineal septum between the bladder and rectum, so that a more or less considerable opening exists, through which meconium or fæces can pass into the bladder. If a free passage can be made in the normal situation into the bowel, the abnormal communication may subsequently close. If such a passage cannot be made, or if the recto-vesical communication persist, when a free channel has been made for the fæces in the normal situation, Littré’s operation should be performed.

The rectum may sometimes be incised in the operations for lithotomy. It is said to happen more frequently than lithotomists are aware of. If so, the wound generally heals speedily. But, if a permanent fistula result, urine will escape into the bowel, and cause irritation and excoriation. Dilatation of the anus will probably bring the rectal opening into view. If it be very small, the application of the actual cautery will suffice, but if it be larger, the edges should be freshened and united by sutures, as in the operation for recto-vaginal fistula. The patient should maintain a lateral or prone position, and any accumulation of urine in the bladder be prevented until union has resulted. If this procedure be not successful, a grooved staff should be intro-

duced into the bladder, and by division of the intervening structures upon it a perineal fistula established. The wound will then heal by granulation.

A similar fistula occasionally resulted from the now seldom practised operation of tapping the bladder through the rectum, in retention of urine.

In malignant disease of the rectum, perforation from ulceration into the bladder may occur. Diversion of the fæces by the operation of lumbar colotomy would be the most suitable treatment; for the escape of fæcal matter into the bladder would probably induce cystitis, and might also give rise to retention of urine from obstruction of the vesical orifice.

Tuberculosis of the anal channel may sometimes result in recto-vesical fistula. Or the disease may originate in the prostate or vesiculæ seminales, and by ulcerating in both directions produce this condition. In this form of the affection, flatus rather than fæces may pass into the bladder or urethra, and urine may escape into the anal passage. The general condition of the patient must determine the propriety of operative interference. The establishment of a perineal fistula, by which the urine would constantly drain into a portable urinal, might give some relief.

JEREMIAH MCCARTHY.

RECTUM, Injuries and Diseases of the. The anus, from its superficial position, is liable to injury, like the rest of the surface of the body, from contusions, burns, and scalds. These do not require any special treatment or description. The orifice of the anus may be lacerated by the passage of large and hard accumulations of fæces, or of bones or similar substances which have been accidentally swallowed. As a rule these heal spontaneously, but in unhealthy subjects, or if bathed in irritating discharges, they may ulcerate. Attention to cleanliness, removal of the source of irritation, and the application of mildly stimulating lotions or ointments will suffice for treatment. In tedious or instrumental labour, pressure on the recto-vaginal septum may result in sloughing and the formation of a recto-vaginal fistula. Or, in the final effort of parturition, the perinæum may be ruptured, and if the laceration extend into the anus, incontinence of fæces will result. For the description and treatment of these conditions, *see* VAGINAL FISTULÆ; PERINEUM, Rupture of the.

Maniacs, idiots, and persons of depraved or weak intellect, sometimes introduce

foreign bodies into the rectum, with more or less injury to the part. Medical literature abounds in instances of this kind. The writer met with a case where a man, in a drunken freak, had thrust an ordinary beer-glass, bottom upwards, into his rectum. It had passed beyond the sphincter muscles, which had firmly contracted. When he applied for relief, after an interval of some days, the rim of the glass was embedded in a deep ulcerated groove in the mucous membrane, which greatly increased the difficulty of extraction. Such cases must be treated according to the conditions of each case, and will sometimes tax to the uttermost the ingenuity of the surgeon. Rough, unskilful introduction of bougies or enema-tubes may sometimes result in perforation of the rectum. If the perforation be below the peritoneum, perirectal inflammation and suppuration will probably ensue. But if the peritoneum be perforated, and especially if nutrient or cathartic enemata have been pumped into its cavity, death from shock or peritonitis will be the most probable consequence. If the injury be recognised at the time, dilatation of the anus and the internal administration of opium and mercury should be employed.

For malformations of the rectum *see* ATRESIA ANI.

The mucous or submucous tissue of the bowel is exceedingly rarely the seat of a *nævoid* growth. Only two instances of this condition have been recorded, for which reference may be made to the *Lancet* and *Medico-Chirurgical Transactions* for 1883. When ulceration occurs, hæmorrhage to an even fatal extent may result. We can only direct attention to the possibility of this condition, and the treatment must be regulated according to the circumstances of each case.

Pain, tenesmus, constipation alternating with diarrhoea, the discharge of mucus, sero-purulent or sanious fluid, or of blood in varying degrees and combinations, are symptoms common to most diseases of the rectum. But, however clearly the history may indicate the nature of the affection, thorough and careful examination of the part must always be made. Patients, especially women, are sometimes most unwilling to submit to this. A surgeon ought never to yield to this objection, however natural. The writer has met with cases where the patient's life had been rendered miserable and the health seriously affected, from treatment directed in accordance with the statements of the patient, and without

examination of the part. Even when the cause may be seemingly apparent, as in fissure, piles, fistula, or the like, careful investigation will sometimes ascertain that these are only secondary results of some lesion higher in the bowel, or of some disease of the bladder or urethra.

Sometimes, especially in women, paresis of the muscular coat of the bowel results from long-continued and neglected constipation. This is known as *atony* of the rectum. From lack of expulsive power, the rectum is enormously distended with flatus or fæces. Careful regulation of diet, and the internal administration of the extracts of *nux vomica* and *belladonna* will usually ensure a restoration of the normal condition.

INFLAMMATION OF THE RECTUM. *See* PROCTITIS.

INFLAMMATION OF THE TISSUES SURROUNDING THE RECTUM. *See* PERIPROCTITIS.

NEURALGIA OF THE RECTUM.—This may be defined as an abnormal excitability of the nerves or nerve-centres of the rectum, and the symptoms vary greatly. Sometimes, patients complain of pain in some parts of the rectum, paroxysmal or constant, unaffected by defæcation, for which no objective cause can be ascertained. Such patients are not infrequently of a markedly hysterical or hypochondriacal temperament, and, in the absence of any local cause, the treatment must be directed to the improvement of the mental condition. When there is no evidence of such disposition, the symptoms may possibly be due to a small exostosis pressing on some of the nerves supplying the rectum, or to some localised affection of the brain or spinal cord. The nervous condition of such patients should be carefully examined. The cases are, however, very rare, and the treatment must be modified according to the circumstances of each case. In other patients, this abnormal excitability may manifest itself by an almost irresistible desire to go to stool at unseasonable or impossible times, without any natural occasion. This has been designated by Curling as irritability of the rectum. As the intestine is now known to abound in many varieties of micro-organisms, by whose influence different decompositions are excited in the contents of the alimentary canal, it is not impossible that some specially irritating substance may be produced from such a cause in the secretions or contents of the rectum. Relief has been experienced, in such cases, by washing out the rectum with lukewarm water, and weak carbolic lotions

might be tried, together with the internal administration of salicylic acid, by which the development of such micro-organisms is checked. But the mental condition has also great influence in these cases, as sometimes the irritability ceases or greatly abates when the patient is assured that he can, if necessary, satisfy his desires.

POLYPUS OF THE RECTUM.—A new growth from the inner wall of the rectum. It is sometimes *papillary*, but more frequently *follicular*. The papillary form consists of elongated papillæ studded with secondary papillæ, usually sheathed with cylindrical epithelium and presenting a tuft-like appearance. The follicular variety is an outgrowth covered with mucous membrane, and has well-developed Lieberkühnian follicles. Muscular and fibrous elements also enter into its formation, and, according to the predominant tissue in it, the growth may be classed as adenoma, myoma, or fibroma. Adenoma and myoma are usually met with in children and young adults, while fibroma occurs more frequently in adults. It has been suggested that this is the result of time, and that the mucous membrane of the young growth may atrophy, and the residue become indurated by chronic inflammation.

The rectal polypus is generally solitary, but may be multiple, and may vary from the size of a raspberry to that of a hen's egg. It is very rarely larger than this, but the multiple variety may, in the aggregate, be large enough to obstruct the bowel.

The *symptoms* also vary. Sometimes a polypus is unnoticed during life, and only discovered by accident on the post-mortem table. Usually, however, it causes a mucous catarrh or hæmorrhage. Bleeding from the rectum after defæcation, in a young child, if there be no accidental injury to account for it, is almost certainly indicative of the existence of a polypus. If the peduncle be of sufficient length, the tumour may be protruded through the anus in defæcation, and is sometimes retained in that position by spasmodic contraction of the sphincter muscles. It is thus exposed to injury, and may ulcerate or become inflamed, and will always cause a disagreeable sensation as if some foreign body were lodged there. It is sometimes associated with ulceration of the mucous membrane of the bowel, especially with the variety known as fissure of the anus. It may also induce prolapse of the bowel or be complicated with internal piles. Sometimes an internal pile, indurated by chronic in-

flammation, is clinically indistinguishable from a fibrous polypus. In the multiple form, the mucous catarrh and hæmorrhage may be so great as to seriously impair the patient's health. This disease greatly resembles the villous growths which sometimes occur in the bladder. They are very rare, but are sometimes met with in more than one member of the same family. The growths present club-shaped protrusions, in some parts closely aggregated, in others more isolated. They are very vascular, and microscopically are found to consist chiefly of glandular tissue. *See VILLOUS TUMOURS.*

The *diagnosis* can only be assured by digital and ocular examinations. In the event of the polypus having an attachment high up in the rectum, the examination should always be made immediately after an action of the bowels, when the tumour will be found either protruding from the anus or within reach of the finger. It could only be confounded with an internal pile, from which the history, situation, and pedicle will sufficiently distinguish it, except in the case of an indurated pile, which is practically a polypus and requires the same treatment. The multiple variety is unlike any other disease of the rectum, and when seen cannot be mistaken.

Treatment, in all cases, consists in ligature of the pedicle and abscission of the growth. Removal without ligature might cause troublesome hæmorrhage. If the pedicle be thin and soft, caution must be observed in applying the ligature, as the pedicle might be torn across and bleeding result. In order to bring the growth within reach of the operator, an enema of warm water is sometimes requisite. In the multiple variety, the growths are sometimes so closely aggregated as to render necessary the removal of the portion of mucous membrane from which they spring. This may be either cut off with scissors or by the galvanic *écraseur*. The more isolated growths should be ligatured and cut off like the solitary polypus. The growths are usually so numerous as to require more than one operation for their removal. The after-treatment in such cases would be the same as for internal piles. The removal of a solitary polypus usually requires no subsequent treatment.

STRICTURE AND OBSTRUCTION OF THE RECTUM.—Stricture of the rectum is an impaired distensibility of some part or parts of this portion of the bowel, caused by structural changes in its walls or in the tissues immediately surrounding it. It must be distinguished from obstruction of the rectum, which may be caused by the

lumen of the tube being more or less completely filled by benign or malignant new-growths from its walls, or else compressed by similar growths from the neighbouring viscera or structures. As both impede or prevent defæcation, they may be treated of in the same article, although their origin and pathology are very different.

Stricture may be annular or tubular, and may be situated at the anal orifice, or at the juncture of the anus and rectum, or of the rectum and sigmoid flexure. These are the most usual situations, but it may be at any part of the rectum. It is usually single, and double stricture occurs very rarely. It may be of congenital origin. If the rectum be imperforate at birth, and if perineal dissection be requisite to expose the lower end of the bowel, stricture of the anal passage not infrequently results, and this is inevitable if the mucous and cutaneous surfaces cannot be united at the time of the operation. Stricture of the anal orifice may result from undue removal of the skin in operating for piles or prolapse, or from cicatrization of deep ulceration caused by disease or accidental injury.

Syphilitic ulceration of the bowel may by cicatrization induce stricture. If the ulceration continue, the reflex irritation produced by it will enhance the effect of the stricture. Such ulceration frequently occurs at the junction of the anus and rectum, and in the portion of bowel immediately above this junction, but it may occur at any part of the rectum. Any ulceration of the mucous membrane, whether simple, dysenteric, or tubercular, may have a similar result; but this rarely happens unless the deeper structures in the wall of the bowel have been involved in the process. Chronic catarrh of the rectum, with cicatricial contraction of the submucous coat may also cause it, and pelvic cellulitis, induced by disease or inflammation of the pelvic viscera, may be another exciting cause. It may also result from cancer.

When a stricture has existed for some time, the bowel above it becomes distended. Its muscular coats are hypertrophied, and the mucous membrane is very frequently ulcerated. If perforation of the bowel ensue, recto-vesical or recto-vaginal fistulæ may result, or, from peri-rectal suppuration, fistulous channels may open in the perineum or surrounding parts. If the stricture be above the anus, the mucous membrane in the lower part of the bowel usually becomes congested and inflamed. Mucous or purulent catarrh, piles, prolapse, and

anal fistulæ are then very frequent complications.

The earliest *symptoms* of stricture are constipation and difficulty in defæcation. But, as these conditions may result from many causes, a stricture may have existed for some time unknown to the patient. If it be inaccessible to ocular or digital examination, the *diagnosis* may present difficulty. The passage of ribbon-shaped motions was formerly regarded as a characteristic symptom. But if the stricture be at the upper part of the rectum, the motions, if there be any, will not have this form, and 'ribbon-shaped' fæces may be passed without the existence of any stricture, if the muscular structure of the rectum be unduly irritable. Constipation alternating with fluid motions, or the habitual passage of pellet-shaped fæces, are better indications. But these conditions may be due to obstruction as well as stricture. Bougies are sometimes deceptive. A fold of mucous membrane or the promontory of the sacrum may arrest the progress of the bougie, and induce the assumption of a non-existent stricture. It is sometimes useful to introduce a well-warmed and pliant O'Beirne's tube, and to pump some water into the bowel as the tube is advanced. It is, however, liable to coil upon itself, and so cause error. In doubtful cases, bimanual examination may be employed in adults with advantage. For this the patient should be placed in the lithotomy position and completely anæsthetised. The bladder having been emptied, the sphincters of the anus should be dilated, and the operator's left hand, well oiled, should be cautiously passed into the rectum. With the aid of the right hand pressed firmly into the left iliac fossa, the upper part of the rectum may thus be thoroughly explored.

If the passage be only moderately constricted, attention to diet and the use of laxative purgatives may enable the patient to live in comparative comfort. But if there be ulceration, the stricture will always be liable to inflammation, and by œdema and congestion of the mucous membrane may completely obstruct the passage. It has also a natural tendency to contraction, and may thus ultimately produce retention of fæces. If, in this condition, operative interference be delayed, ulceration and perforation of the distended bowel may result, and cause rapidly fatal peritonitis. This ulceration very frequently occurs in the cæcum. The treatment of stricture will vary with its position and cause. If it be at the anal orifice, a plastic operation,

planned according to the circumstances of the case, sometimes effects a complete cure. If it be in the lower part of the rectum, dilatation may be employed. For this, laminaria tents are very serviceable. A tent of suitable size, with a long firmly attached tape loop, should, when lubricated with glycerine, be passed into the stricture and left there for twenty-four hours. When it is withdrawn, the passage will be found to be greatly enlarged, and the introduction every second day of a gum elastic bougie, well softened in warm water, will prevent a recurrence of contraction. The size of the bougie may with advantage be gradually increased. The bougie should not be introduced by the patient or any inexperienced attendant, for ill-directed efforts have in some cases led to perforation and a fatal result. If there be ulceration, appropriate treatment must be employed. But if it be extensive, the patient's comfort and prolongation of life will be best attained by the operation of left lumbar colotomy. As a regular daily evacuation can then be insured without discomfort, and as the ulcer will no longer be irritated by the passage of fæces, the patient's health will improve, the local pain cease, and the diseased surface be placed under more favourable conditions for repair.

Lumbar colotomy is also the best mode of treating strictures at the upper part of the rectum, and so inaccessible for dilatation, if they cause retention of fæces; and for all strictures complicated by recto-vesical or recto-vaginal fistulæ, or by perirectal sinuses opening on the perineum or adjacent parts. In some cases, when colotomy has been performed for persistent retention of fæces in consequence of a stricture at the upper part of the rectum, motions will, after a short time, again pass through the rectum. This results from relaxation of the stricture when no longer irritated by the accumulation of fæces above it, and by the straining efforts to expel them. If the condition of the rectum be curable, the lumbar opening may be closed when occasion for it has ceased. But, as a rule, it causes very little inconvenience, which is cheerfully endured by patients who have experienced the discomfort and danger of retention or difficult evacuation of fæces.

Forceible dilatation of rectal strictures by specially contrived instruments, or by water pressure, is very dangerous. The incision of the stricture in one or many parts, though advocated by some surgeons, does not appear to be free from danger of pyæmia or perirectal inflammation. Recently, linear

proctotomy has been performed, with alleged good results, for simple strictures near the lower end of the rectum. For this purpose, a suitably curved trocar and canula should be introduced into the rectum, passed through the wall of the bowel above the stricture in the median line posteriorly, and through the cutaneous surface below the coccyx. The trocar having been withdrawn, the wire of an *écraseur* should be passed through the canula, and all the structures within the loop of wire slowly cut through. The galvanic *écraseur* may also be used for this purpose. The wound should be dressed in the ordinary way, and allowed to heal by granulation.

Obstruction of the rectum, due to growths within the bowel or to pressure from without, will cause symptoms similar to those of stricture. Very rarely, a large fibroid polypus may be the cause, or more rarely still some other benign growth. Syphilis may sometimes produce it by broad outgrowths from the mucous membrane. Cancer of the rectum is a frequent cause, and, in these cases, sometimes stricture and obstruction from new growths are combined. Malignant disease of the bladder, or uterus and ovaries, sarcoma of the sacrum, or even hydatid tumours, may occasion obstruction. When a fibroid polypus or other benign growth exists, it should be removed in the appropriate manner. Obstruction from syphilis should be treated with anti-syphilitic remedies, and, if relief be not speedily derived, colotomy should be performed. In obstruction from any other cause, colotomy will be necessary to relieve the immediate retention of fæces, and in some cases as a preliminary to further operations, such as excision of the lower part of the rectum. When the obstruction is due primarily to disease of the uterus, the possibility of obstruction of the cæcum or some part of the small intestine as well as of the rectum, should be remembered, and careful examination of the abdomen be made by percussion and palpation; so as if possible to determine whether left or right lumbar colotomy or enterotomy would be the most suitable procedure.

ULCERATION OF THE RECTUM.—The mucous membrane of the rectum is liable to ulceration from many causes. The passage and presence of fæces or flatus have no injurious effect on the normal mucous surface. But, if there be any lesion of this surface, the deeper structures do not possess this immunity, and may thus become the seat of inflammation and suppuration from the irritation of fæcal matter or of intestinal

gases. Simple ulcers may therefore result from wounds caused by fish-bones or the like, which have been accidentally swallowed, or by roughly introduced enematubes or other instruments.

Chronic catarrh may, by long-continued maceration, render the mucous surface liable to abrasion and so induce ulceration. The solitary lymphoid glands of the rectum are, like those in the other parts of the intestine, liable to inflammation and suppuration, and if the resulting abscesses burst into the rectum, funnel-shaped ulcers of minute size will result. These, if many in number and close together, may become confluent, and so cause destruction of a considerable extent of mucous surface.

Dysentery, tuberculosis, syphilis, and malignant disease of the rectum, frequently produce ulceration.

Leucorrhœal or other vaginal discharges may also cause ulceration of the anal orifice or passage.

Follicular, dysenteric, and tubercular ulcers are not limited to the rectum, and affect a more or less considerable extent of the rest of the intestine. They belong, therefore, to medical rather than surgical practice, and surgical interference is only required if perforation of the rectum has occurred, when pelvic cellulitis, ischio-rectal abscess, and perineal, recto-vesical or recto-vaginal fistulæ may result.

The *symptoms* of simple ulceration will vary with the situation of the ulcer. If it be at the orifice or in the anal passage, the patient will probably experience pain in defæcation, and there may be great spasm of the sphincter muscles. There will always be a discharge of muco-purulent or purulent fluid, and sometimes of blood. If the ulcer be above the anus, there will not usually be any pain, and the discharge alone will indicate that the condition of the part is abnormal. Digital and ocular examination must ascertain the cause. Sometimes, an ulcer may exist without the patient being in any way aware of it.

The *treatment* is sufficiently simple. Attention to diet, mild laxatives, and iodoform in powder or as an ointment, or cotton wool steeped in a two per cent. solution of nitrate of silver applied locally, will usually ensure healing. If there be much pain or spasm, forcible dilatation of the anus when the patient has been anæsthetised will produce temporary paresis of the sphincter muscles, and so expedite the case by relieving pain. If the ulceration result from chronic catarrh, the exciting cause

must be removed and then the above treatment employed.

Syphilitic ulceration may occur in any stage of the disease. The anal orifice or passage may be the seat of a primary sore from accidental infection or unnatural intercourse. It will cause pain in defæcation, and may from irritation by fæcal matter become very large. The induration and the indications of syphilis in lymphatic glands, &c., will render the diagnosis easy. Ordinary anti-syphilitic treatment will, with attention to cleanliness, suffice. Phagedenic ulceration must be treated, as elsewhere, by cauterisation with nitric acid or chloride of zinc, hot baths, poultices, tonics, and abundant nutriment.

The loss of tissue is considerable, and stricture of the orifice generally results. This must be treated by dilatation or a plastic operation, according to circumstances.

In the secondary stage, mucous papules in the anus or condylomata round it may, in unhealthy subjects, suppurate and produce extensive serpiginous ulceration. Iodide of potassium in five-grain doses, hot baths, iodoform in powder, and, if necessary, cauterisation with nitric acid will be the suitable mode of treatment.

In the tertiary stage, the lower part of the rectum is, especially in women, a frequent seat of syphilis. The submucous tissue may be uniformly infiltrated so as to produce rigidity and stenosis of the bowel, or gummata of large size may cause projections into the lumen of the tube, or numerous minute gummata may form and gradually extend for a considerable distance up the rectum. Ulceration of the mucous membrane speedily ensues. The patient will suffer from obstruction or stenosis of the bowel. The discharge of sanious, offensive fluid is abundant, and the pain is often very severe. Perforation into the vagina frequently occurs. The diagnosis is often very difficult. A history of syphilis or evidence of the disease in other parts of the body may indicate the nature of the case; but, when the distance is extensive, it does not yield readily to anti-syphilitic treatment. In such cases lumbar colotomy would be most suitable, and, the ulcerated surface being no longer irritated by the passage of fæces, would be more likely to heal. In less severe cases, irrigation with dilute Condyl's fluid, and the internal administration of decoction of bark with biniodide of mercury, will be found beneficial. One-drachm doses of the liq. hydrargyri bichloridi, with five-grain doses

of the iodide of potassium, will be found to be a most convenient method of administering the biniodide of mercury.

MALIGNANT DISEASE OF THE RECTUM.—

The mucous membrane of the rectum at, and for some extent above, its junction with the anus, is not infrequently subject to hyperplasia. This at first results in considerable enlargement of Lieberkühn's follicles, and, as secondary consequences of irritation, hypertrophy of the tunica mucosa muscularis and infiltration of the submucous tissue with leucocytes. The growth may be greater at some parts of the circumference of the bowel than at others, with the result of irregular projections into the lumen of the tube. There is also increased vascularity. If this be all, the growth is benign, and forms the superficial adenoma of Klebs. But, if the continuity of the membrana propria or basement membrane be broken through, and if the epithelial cells grow or pass along the lymph-channels among the component elements of the other structures of the bowel, it becomes true cancer. The immigrant cells form centres for new epithelial growths, which produce, by irritation, changes in the surrounding structures. These growths contribute to the obstruction of the bowel, and by pressure may produce atrophy and ulceration of the mucous surface. The disease may in this manner extend along the bowel, or invade the perirectal tissues and neighbouring organs, such as the vagina, prostate, or bladder. If perforation of the bowel ensue, ischio-rectal suppuration and perineal sinuses may result, or fistulous communications form into the vagina or bladder. The lymphatic glands in connection with the bowel, and the liver through the portal system of veins, may be the seat of secondary growths, and cancerous cachexia ensue.

If the irritative process predominate in the growths, scirrhus will result, with induration and contraction of the walls of the bowel. This variety of cancer does not occur frequently in the rectum. If the epithelial growths form the chief part, the cancer is soft or encephaloid. In this variety there is less induration and contraction, but the lumen of the bowel is obstructed by large, very vascular growths, which are sometimes of the cauliflower form and are very liable to slough. The epithelial new-growth tends to develop according to the type of the normal epithelium of the part from which it is derived. Microscopic examination of soft cancer of the rectum usually discloses, therefore, a

tubular structure, the tubules being sheathed with a single layer of cylindrical epithelial cells, and resembling Lieberkühn's follicles. This constitutes what is known as cylindrical-celled or adenoid carcinoma or epithelioma. Colloid cancer will result from the corresponding degeneration of the epithelium, so that elements of the new growth resemble boiled sago-grains embedded in the surrounding indurated tissues. Melanosis also sometimes occurs in the rectum.

The *symptoms* are at first very indefinite. As the disease is usually painless until ulceration has taken place, constipation and difficulty in defæcation are the first indications. When ulcers form, discharge of sero-purulent or sanious fluid or of blood will occur, but, if the case be complicated with piles, the source of the discharge may be mistaken. Careful exploration of the rectum should therefore be made in all cases of constipation or of purulent or other discharge from the bowel. When the growth presses upon the nerves of the sacral plexus, cramps and painful sensations in the lower extremities are often experienced. If the bladder or prostate be involved, there may be difficulty in micturition, and the passage of fæces into the bladder through a fistulous opening will very probably produce cystitis. As the ulceration progresses, pain in defæcation increases, and complete obstruction of the bowels often results; partly from the occlusion of the tube by growths or by contraction, and partly from the arrest of peristalsis, in consequence of the muscular fibres of the bowel being destroyed or impaired. The rate of progress will vary with the nature of the cancer. In the firm, contracting variety, it is much less rapid than in the encephaloid form.

Cancer of the other pelvic viscera may, by direct continuity, invade the rectum. In such cases, obstruction of the bowels will, so far as regards the rectum, usually be the chief symptom.

The anal passage is sheathed with squamous stratified epithelium, and the external orifice is abundantly supplied with anal glands. The epithelium of these glands, or of the rete mucosum, may be the starting point of new growths. When these have perforated the basement membrane, epithelioma of the anus is the result. It usually commences as a small nodule or wart, which has sometimes been mistaken for an external or intermediate pile. The surface, however, soon becomes fissured and ulcerated, and bleeding or sanious discharge results. The disease generally extends along the cuta-

neous surface round the anus, but it may also pass up the bowel, or in both directions simultaneously. Anal epithelioma is much more painful than rectal cancer. The pain during defæcation is very severe, and it is also more constant than in the rectal disease, and often radiates to distant parts.

The *diagnosis* of malignant disease of the rectum does not usually present much difficulty. Syphilitic ulceration is alone likely to be mistaken for it. The margin of the anus is sometimes from accidental infection, or from unnatural intercourse, the seat of a primary syphilitic sore. If this be of an unhealthy character, it may very greatly resemble an epitheliomatous ulcer. But anal epithelioma is usually an affection of advanced life, and primary syphilis would probably occur in younger persons. The history of the case, the presence or absence of other indications of syphilis, and the result of antisiphilitic treatment, in doubtful cases, should render the diagnosis certain. Syphilitic ulceration of the rectum is not so readily distinguishable from cancer. The lower part of the rectum is a frequent seat, especially in women, of tertiary syphilitic growths, which may be of sufficient size to considerably obstruct the tube, and when ulceration ensues the resemblance to cancer is very great.

Some writers suggest microscopic examination of shreds detached from the ulcerated surface as a diagnostic means; but while it might possibly corroborate a diagnosis formed on other grounds, in really difficult cases it would not be of much service, and the suggestion appears to be theoretical rather than practical. The history of the case, the general condition of the patient, and the effect of antisiphilitic treatment would form the best grounds for a diagnosis; and in bad cases, the palliative treatment of lumbar colotomy would be the same for both affections.

Treatment.—Anal epithelioma must be freely removed as in other parts of the body, unless the disease has progressed too far to admit of operation. If the growth be limited in size and superficial, it may be at once excised, and hæmorrhage arrested by ligature of vessels or by the actual cautery. Iodoform in powder would be the best subsequent application. But if the extent of the disease requires the removal of a portion of the anal wall, the passage should be forcibly dilated, and a curved incision of suitable extent should be made in the healthy skin corresponding in situation to the part that is to be removed. The dissection

should then be carried up through the perineal tissues, until the upper limit of the growth has been passed, and the diseased portion removed by the ordinary or galvanic *écraseur*, or with the knife or scissors, according to the circumstances of the case and the predilection of the operator.

When the anterior wall has to be removed, the introduction of a full-sized metal catheter into the bladder will be of service in indicating the position of the urethra and prostate gland. If the whole of the anus must be removed, the incision must be made correspondingly, and the isolated bowel excised with the *écraseur*. Some recommend the preliminary insertion of ligatures a little above the proposed line of excision, which may afterwards be used to unite the mucous and cutaneous surfaces. If this can be accomplished, the liability to subsequent stricture will be greatly diminished; but, as a rule, the tension of the parts is such as to cause the sutures to cut through and be useless.

Cancer of the rectum has latterly, owing to the enterprise of Continental and more recently of English surgeons, been treated by operation much more than was formerly deemed possible or justifiable. Experience has proved that three or four inches in length of the bowel can be removed with safety at the time of the operation, and with the result of complete cure in some cases, and of great amelioration in others. The indications for removal are that the upper limit of the growth should be accessible, and should not be so far from the anal orifice as to endanger wounding the peritoneum during the operation; and that the disease should be limited to the rectum and not involve the other pelvic viscera. The absence of secondary growths in lymphatic glands or in the liver should also, so far as possible, be ascertained. These conditions being fulfilled, an extension upward of the dissection required for removal of the anus until the upper limit of the growth has been passed, and the removal of the isolated bowel by the *écraseur*, would suffice. Attempts to unite the mucous and cutaneous surfaces are useless. Opening the peritoneal sac very seriously affects the chance of a successful result. In order to so far as possible prevent this occurrence, the bladder should be distended by injections of water, by which the recto-vesical fold of peritoneum would be considerably elevated. If it should be wounded, the aperture, if small, should be closed by a ligature, and, if large, a drainage-tube should be inserted,

and opium freely administered. In all such operations, and also when the whole or a large part of the anus is to be removed, lumbar colotomy is, in the writer's opinion, most advisable as a preliminary. When this has been performed, a daily painless evacuation can take place, the nutrition of the patient is not interfered with, the ulcerated bowel is no longer irritated by the passage of fæces, or by the existence of fetid gases resulting from the fermentation of retained fæces; and the wound caused by the subsequent operation is also free from such noxious influences.

In some cases, a portion only of the wall of the rectum will require removal. This can be accomplished after forcible dilatation of the anus, or division in the median line posteriorly of all the tissues from the mucous membrane to the skin, extending as high as the tip of the coccyx. The requisite portion of the rectum can be removed with scissors or the *écraseur*. Incontinence of fæces is not very frequently a result of these operations.

In cases where removal of the growth is impossible, lumbar colotomy will be the best palliative treatment. Careful irrigation of the rectum, with carbolic acid solution or with diluted Condyl's fluid, should also be employed. Scraping the ulcerated surface, and subsequently applying the actual cautery to it, are sometimes of service, and appear, for a time at any rate, to promote a growth of healthy granulation-tissue.

Sarcoma seldom occurs primarily in the rectum, but may invade it from other surrounding parts. It is not impossible that some of the recorded cases of encephaloid cancer may really have been sarcomata, in the days when the microscopic characteristics of both kinds of growth had not been so clearly distinguished as they have been in later times. The treatment would be the same as for cancer.

See also FISSURE OF THE ANUS; FISTULA IN ANO; HÆMORRHOIDS; PERIPROCTITIS; PROCTITIS; PROLAPSUS ANI ET RECTI; PRURITUS ANI; RECTO-VESICAL FISTULA.

JEREMIAH MCCARTHY.

REDUCTION EN BLOC, or EN MASSE. *See* HERNIA, Strangulated.

REFRACTION, Errors of.—In this article the following abbreviations are employed:—A., accommodation; As., astigmatism; D., dioptré; E., emmetropia; F_h, horizontal focus; F vertical focus; H., hypermetropia; M., myopia; V., vision;

+^{vx}, convex; -^{ve}, concave; <, less than; ', one foot or one minute; ", one inch or one second; ∪, combined with.—The function of the refracting apparatus of the eye is to bring rays proceeding from external objects to a focus on the sentient layer of the retina, and thereby give a distinct image of such objects. The calculation of the passage of rays of light through the various media of the eye—cornea, lens, &c.—is a very complicated one; in order to simplify it, it has been proposed to substitute for the actual eye a diagrammatic one consisting of a single refracting surface, bounded anteriorly by air and posteriorly by vitreous humour. The dimensions of such an eye have been fixed by Donders as follows:—Radius of curvature of the single refracting surface (the cornea) = 5 mm.; total length of the eye from cornea to retina = 20 mm.; distance of nodal point behind the cornea = 5 mm.; index of refraction = $\frac{4}{3}$. It will

be seen that the nodal point coincides with the centre of the cornea. This goes by the name of the 'reduced eye' of Donders; with it calculations about the optical properties of the eye are very simple, and the results are so nearly correct as to suffice for all practical purposes.

The relation between the refractive power and the length of axis of the 'reduced eye' is such, that parallel rays falling on the cornea are brought to a focus on the retina. Such an eye is called *emmetropic*, or is said to be in a condition of *emmetropia* (E.). This relation may be disturbed, so that the focus of entering parallel rays is either (1) anterior to the retina or (2) posterior to it; in the former case the eye is called *myopic*, or is said to be in a state of *myopia* (M.); in the latter the eye is called *hypermetropic*, or is said to be in a state of *hypermetropia* (H.).

In neither of these cases is a distinct image of a distant external object formed on the retina; the image of any *point* of such an object is not a *point* on the retina, but a circle of diffusion, the rays proceeding from the external point having come to a focus before reaching the retina in (M.), or being on their way to a focus behind the retina in (H.). In both cases the image of the external object is a number of overlapping circles of diffusion, and is therefore blurred.

There is a third anomalous condition of the eye, in which the image on the retina of an external point is not itself a point; this is the affection known as *astigmatism* (As.), which we shall describe later on.

These three departures from *emmetropia*—viz. *myopia*, *hypermetropia*, and *astigmatism*—are what we have to consider. They are often collectively described as *ametropia*.

Before the description of these affections a few words must be said about—(1) *the numbering of lenses*; (2) *the accommodation of the eye*; (3) *the determination of the acuity of vision*.

Numbering of Lenses.—Till a few years ago, lenses were numbered according to their *focal length*, generally expressed in inches, and the unit of measurement taken was a lens whose *focal length* was one inch, and whose *focal power*, therefore, being the reciprocal of the focal length, would be expressed by unity. Nearly all other lenses with which oculists have to deal are of a longer focal length than one inch, say twelve or twenty inches. The focal power of these lenses would be expressed by fractions $\frac{1}{12}$ and $\frac{1}{20}$ in the cases we have chosen for illustration. Working out combinations of these lenses necessitated much troublesome calculation of fractions. To avoid this, as well as other disadvantages, the *metrical system* of numbering lenses has been suggested, and is now almost universally adopted.

Here the unit of measurement is a lens whose focal length is 1 mètre. The focal power of this lens is called a *dioptre* (1 D); shortly, the lens itself is called a *dioptre*. A lens of twice the refractive power, and whose focal length is therefore half a mètre, is called 2 dioptres (2 D). A lens of half the focal power of the first will be .50 D, and have a focal length of 2 mètres, and so on. The focal lengths are better expressed in centimètres; thus the focal length of a lens of 1 D is 100 cm.; of 2 D, 50 cm.; and *generally* the focal length of a lens is found in centimètres by dividing 100 by the number of the lens in dioptres; and conversely the focal power of a lens is found in dioptres by dividing 100 by the number of centimètres in the focal length.

For example, take a lens of 5 D; what is its focal length in centimetres?— $\frac{100}{5} = 20$; therefore the focal length is 20 cm.

Again, what is the focal power of a lens of 40 cm. focal length?— $\frac{100}{40} = \frac{5}{2} = 2.50$; therefore the strength of the lens is 2.50 D.

Of course the signs + and - are prefixed to numbers denoting the strength of the lens according as the lens is convex or concave.

To convert from inches to dioptres is equally simple. Only English inches will

here be referred to. A mètre = 40 in. nearly; therefore a lens of 1 D has focal length of 40 in., and therefore a focal power of $\frac{1}{40}$, according to the old notation. A lens of 3 D is three times as strong as the first; therefore its focal power, according to the old notation, is $\frac{3}{40}$, and its focal length $\frac{40}{3} = 13\frac{1}{3}$ in.

The general rule is: to find the number of D in a lens, divide 40 by its focal length in (English) inches; to find the focal length of a lens in (English) inches, divide 40 by the number of D in the lens.

Thus a lens whose focal length is 12'' is $\frac{40}{12} = 3\cdot5$ D (nearly); and a lens of 7 D has

a focal length = $\frac{40}{7} = 6''$ (nearly).

In the following article lengths will, as a rule, be expressed in mètres and centimètres; occasionally the equivalent in feet or inches being given. It is useful to remember that, approximately, 1 mètre = 40''; 1 cm. = $\frac{2''}{5}$; 1 mm. = $\frac{1''}{50}$.

ACCOMMODATION (A.).—All eyes have the power of increasing by a muscular effort their refractive power; this is known as the power of accommodation. This is not the place to discuss the physiology of the act; all we are concerned with is the measure of it. Donders showed that the amount of accommodation was independent of the refractive condition of the eye, and depended only on the age of the individual. It is very convenient to imagine that the eye, in calling into action its power of accommodation, takes to itself an auxiliary convex lens, the strength of which equals the increase of refractive power caused by the accommodative effort. This auxiliary lens ought, strictly, to be imagined as being placed in the position of the nodal point of the eye, but we may, without an error of practical importance, suppose it placed in front of the eye, in the position of an ordinary spectacle-glass. This way of looking upon accommodation, as a power residing in the eye of placing in front of itself a magnifying glass of suitable strength, will be found very useful when we come to examine the various errors of refraction.

The strength of this imaginary auxiliary lens is best expressed in dioptries.

The greatest amount of accommodation an eye can exert is called its *amplitude of accommodation*.

Donders drew up the following table of the amplitude of accommodation possessed by the eye at different ages:—

Age	Amplitude of Accommodation	Age	Amplitude of Accommodation
10 years	14 D	40 years	4·5 D
15 "	12 D	45 "	3·5 D
20 "	10 D	50 "	2·5 D
25 "	8·5 D	55 "	1·75 D
30 "	7 D	70 "	·25 D
35 "	5·5 D	75 "	0·00 D

In making the experiments on which this table is founded, the eye was tested alone, without the co-operation of the other eye. This is hence called the *amplitude of absolute accommodation*; when both eyes are uncovered, the *amplitude of binocular accommodation* is obtained. This is somewhat different from the results in the above table. See ACCOMMODATION OF THE EYE.

DETERMINATION OF THE ACUITY OF VISION.—The standard proposed by Snellen, and now generally adopted, is that a letter should be recognised, under proper illumination, when it subtends an angle of 5', the breadth of its limbs being one-fifth of its height, and therefore subtending an angle of 1'.

A scale of test-types has been constructed on this principle by Snellen. The scale consists of a series of rows of square Roman letters; each row has a number, which expresses in mètres the distance at which the letters in the row are seen under an angle of 5', and should therefore be recognised by a normal eye.

A special card is made for testing the sight at a distance so considerable that rays diverging from a point at that distance may be considered parallel. This card has seven rows of letters, which bear the numbers 60, 36, 24, 18, 12, 9, 6; it is most conveniently placed at a distance of six mètres (about twenty feet), that being the distance at which the letters of the row 6 should be made out. The acuity of vision (for which the symbol *v* is commonly used) is expressed by a fraction, of which the numerator is the distance at which the card is placed—viz. six mètres, and the denominator the number appended to the smallest row of letters which can be read.

Thus, if the smallest row of all is read, $v = \frac{6}{6}$; if row 12, $v = \frac{6}{12}$, and so on. If the types be placed at a different distance, it will be necessary to alter the numerator; for instance, if they be placed at four mètres, and the row 9 of the above card be the smallest read, $v = \frac{4}{9}$; at this distance we

have no types on the card small enough to express unity, which represents the standard of distinct vision; to do this, we should have to add to the card smaller letters still. It is immaterial what distance be chosen, so long as it is great enough for rays proceeding from that distance to be practically parallel; but six mètres, having come into general use, may be conveniently adopted for the sake of uniformity. Before the metrical system was generally adopted, distances were expressed in feet, and the numbers appended to the rows of letters correspondingly altered. Thus the row of largest letters was No. 200, the others being 100, 70, 50, 40, 30, 20.

In this case, the row of smallest letters being seen at twenty feet, v would be $\frac{20}{20}$ instead of $\frac{6}{6}$ as above; decreasing acuity of vision would be expressed by $v = \frac{20}{30} = \frac{20}{50}$, and so on, corresponding to $v = \frac{6}{9}$, &c.

In addition to the distance-test, eyes are often examined with smaller types at short distances; for this, Snellen's series may still be used; but the types of Jaeger are generally preferred. These are numbered 1, 2, 4, up to 20. In testing the sight, the number of the type that is read, and the distance at which it is read, should be noted.

It is necessary to ascertain not only what the unaided eye can read, but also what help lenses afford. For this purpose the surgeon should be provided with a case of test-glasses. This contains a series of pairs of convex lenses of increasing strength, from .5 D up to 20 D; a similar series of concave lenses, convex and concave cylindrical lenses, prisms, trial frames, &c. Each eye should be tested, and the result noted, separately.

It will be found a great saving of time to set to work methodically; the following procedure is recommended:—A trial frame is fitted on the patient's face, and an opaque disc placed in front of the left eye, so that the right eye is uncovered for testing. The patient is then invited to read Jaeger's No. 1, holding the types at any distance he chooses; if he fails to read Jaeger 1, he is tried with Jaeger 2, 4, &c., still at his own distance, till the smallest type he can read is found. This is noted, and also the distance at which he holds it for reading. Not much stress need be laid on this reading of *near* types as a test of acuity of vision; a presbyope, for instance, with perfect acuity of vision,

might not be able to read even large letters near at hand unaided by convex glasses.

The test is now continued with the *distant* types. And here it should be explained that, in ophthalmic works, a *distant* object means any object that is so far distant from the eye that rays proceeding from it may be considered to enter the eye practically parallel. This distance is conventionally put at about six mètres; in the following pages we shall then mean by a *distant* object an object at about six mètres.

The patient is accordingly invited to read Snellen's card of types placed at six mètres; he is told to begin at the row of largest letters, and read the other rows upwards or downwards as the case may be; the result is then noted. Further, the effect of putting + and - glasses in the trial frame is noted; but we must wait till the errors of refraction have been discussed before this effect can be appreciated. Suppose the patient reads Jaeger's 2 at 10'', and at six mètres row 9; the result would be thus noted—

R.E. (right eye.)

J. 2 at 25 cm.

$$v = \frac{6}{9}.$$

If we wished to examine the *near* vision more closely, we ought to find his near and far point. In the above case, for example, the patient might be able to bring J. 2 up to within 10 cm. of his face, and still read it, or remove it to 30 cm., and still see it.

This might be noted thus: J. 2, 10 cm. — 30 cm. In finding the far point, care must be taken to test the eye with print adapted to the distance of that point from the eye. Thus, J. 1 is too small to be seen by an eye of good visual acuity at a greater distance than 35 or 40 cm. Beyond this distance larger print must be used. See VISUAL ACUITY.

The various errors of refraction may now be discussed; these being (a) *myopia*, (b) *hypermetropia*, (c) *astigmatism*.

(a) MYOPIA.—Here parallel rays come to a focus in front of the retina. This may arise either from an increase of refractive power in the dioptric apparatus of the eye, the entering parallel rays being consequently bent more abruptly, or from an increase in the length of the eye. It is usually due to the latter cause—the axis of the eye is too long. It is convenient, however, to consider it as depending on an increase in the refractive power of the eye; as it is only the *relation* between these two factors that we are concerned with, this way of viewing the matter is practically correct

We say, then, that in M. the refractive power of the eye is too great. We may imagine that a myopic eye is an emmetropic eye armed with a convex lens in front of itself, just as we did in considering accommodation. The strength of this hypothetical lens will then express the amount of M. For instance, in M. of 4 D, this lens is 4 D; this will make parallel rays diverging from its principal focus—i.e. from a distance of $\frac{100}{4}$ cm.; such parallel rays entering, then, the emmetropic eye, which we have considered combined with the convex lens to form the myopic eye, will be brought accurately to a focus on its retina, and therefore an external object, at a distance of $\frac{100}{4}$ cm. from this myopic eye, will be seen distinctly. Objects at all other distances will be seen indistinctly, so long as the accommodation of the eye remains at rest.

A myopic eye, however, has the power of accommodation like any other eye; this power, we have seen, is equivalent to placing in front of the eye a convex lens, of the strength necessary to focus on the retina rays from any object which such an eye can possibly see. It is evident that all objects situated farther from this myopic eye than $\frac{100}{4}$ cm. are out of its range of distinct vision. Rays from such objects are already brought to a focus in front of its retina; the calling into action of the power of accommodation would only bring them to a focus still farther in front of the retina, and consequently make the images more blurred. It is different, however, with objects situated nearer the eye than $\frac{100}{4}$ cm.; rays from such objects unite behind the retina, and an appropriate convex lens will bring them exactly to a focus on it; this lens the eye, bringing into play its accommodation, automatically selects when a distinct image of such objects is desired. There is a limit, however, in this direction also. An eye has at its disposal only a certain amount of accommodative power, expressed by a convex lens of a certain number of dioptries; this must not be exceeded.

An example may make this clearer. Keeping still to the eye with M. = 4 D, let us suppose that the amount of accommodation at its disposal = 6 D. Then, with A. altogether in abeyance, the eye will see distinctly only objects at a distance of $\frac{100}{4}$ cm. Suppose now it calls into play 2 D of its A.; it is then

in the position of an emmetropic eye with a lens = + 6 D in front of it [4 D for the M. and 2 D for the A.]. The eye then will see objects distinctly at a distance of $\frac{100}{6}$ cm. If 5 D of its A. be used, objects will be seen distinctly at $\frac{100}{4+5} = \frac{100}{9}$ cm.

If the whole of A.—i.e. 6 D—be called into use, the only distance of distinct vision will be $\frac{100}{4+6} = 10$ cm. This is the nearest point of distinct vision. The farthest point of distinct vision is, as has been shown above, $\frac{100}{4} = 25$ cm. This eye, then, has a range of distinct vision between the distances of 10 cm. and 25 cm. measured from itself.

The nearest point of distinct vision is called the *punctum proximum*, or *near point*, and its distance from the eye is denoted by P; the farthest point of distinct vision is called the *punctum remotum*, or *far point*, and its distance from the eye is denoted by R; R—P is then the distance over which the eye has distinct vision, and $\frac{100}{P} - \frac{100}{R}$ = the number of D in the amplitude of accommodation [P and R being expressed in cm.].

Moreover, the lens which expresses the amount of M. is that whose focal length = R, and which therefore = $\frac{100}{R}$ D.

Etiology.—M. does not often appear before the eighth or ninth year; it generally progresses till adult age is reached. It is frequently hereditary, but may be induced by constant use of the eyes on very fine work, as that of watchmakers, &c. It is relatively common amongst the more civilised communities, and the more studious sections of those communities. M. occurs very frequently in those who have had defective sight from childhood; this is probably due to their constantly bringing objects close to the eyes, in order to get large retinal images. Any disease which causes increased curvature of the cornea will also cause M.; the most remarkable instance of this is ‘conical cornea.’

The amount of M. varies within wide limits; up to 4 D would be called a low grade; 10 to 12 D is a pretty high amount, but much higher degrees occur—up to 20, 25, and even 30 D. The amount is often not the same in both eyes.

Symptoms.—In the low degrees, the only inconvenience is, usually, that the patient

cannot distinctly see distant objects. For near ones the sight is uncommonly good; in looking at distant things the myope partially closes the eyelids in a very characteristic manner; in this way he is able to narrow the circles of diffusion, and thus get a more distinct image.

In the higher degrees, the eye is seen to be decidedly too prominent; the patient complains of aching of the eyes on working, especially by artificial light; there is a constant feeling of tension; sometimes severe headache; flashes of light and muscæ volitantes. All these troubles are generally the greater the higher the degree of M.; they are worst of all when M. is rapidly increasing. In the high degrees there may be considerable diminution of the acuity of vision.

Diagnosis and Measurement.—If distant vision be improved by concave glasses, it is generally speaking a case of M.; sometimes, however, H. simulates M. This will be referred to later on. In examining a case where M. is suspected, it is most convenient to test the vision for near objects first. If the patient complains of very defective distant vision, whilst No. 1 of Jaeger's test types is read close at hand, it is almost certainly a case of M. To estimate the amount of M., find the *punctum remotum*—i.e. find the greatest distance at which the patient can read Jaeger 1 or 2. We have seen above that R is the focal length of the lens that measures M. Suppose, for instance, R = 20 cm.

$$\text{Then } M. = \frac{100}{20} \text{ D} = 5 \text{ D.}$$

But the accurate estimation of M. must be made with Snellen's large test-types at 6 mètres. A myopic eye, we have seen, may be regarded as an emmetropic eye armed with a convex glass, the strength of which is a measure of the M. We know the strength of this hypothetical convex lens, if we know the concave lens that neutralises it—i.e. brings the eye into the condition of an emmetropic one. Now the characteristic of an emmetropic eye is that it brings parallel rays to a focus on its retina, and therefore, if healthy, has the normal acuity of vision for distant objects, i.e.—has $v = \frac{6}{6}$.

We find, then, the weakest concave lens, which in the case of the myopic eye gives $v = \frac{6}{6}$; and this lens gives us the amount of M. It may be that no concave lens brings v up to $\frac{6}{6}$; in this case there must

be some other condition complicating the M.; some astigmatism, perhaps, or some degenerative change in the retina. Here we find the weakest concave lens, which gives the *best attainable acuity of vision* at 6 mètres, and this we take to be a measure of the M. It must be the *weakest* concave lens; with a stronger concave lens v might still be as good, but the lens would not represent the amount of M.; accommodation would be called into play to the amount necessary to correct the excess of strength of the lens; and this latter would represent not only the M. of the eye in a state of rest, but also the amount of accommodation so exercised. Take, for instance, an eye for which, with the small types, we find R = 15 cm.

This would give as a rough estimate $M. = \frac{100}{15} = 7 \text{ D}$ nearly. We put up -7 D

in the trial frame, and find $v = \frac{6}{9}$; we hold up in front of this glass an additional -1 D ; we now find that $v = \frac{6}{6}$. M. then = 8 D.

If now we put up -8 D in the frame and hold an additional -1 D in front of this, we may still find that $v = \frac{6}{6}$. It would

be an error to say, however, that M. = 9 D. What happens when we put up this additional -1 D is this: -8 D has brought the parallel rays coming from the test-types accurately to a focus on the retina, as is proved by the fact that with this glass the eye has the standard acuteness of vision; when -1 D is put up in addition, it makes these parallel rays divergent. To focus these on the retina the eye must increase its refractive power to the extent of 1 D, and this it does by unconsciously calling A. into play to that extent.

If we were to put up -11 D in the trial frame we should still probably get $v = \frac{6}{6}$; in this case 3 D of A. would be in action, neutralising the excess of 3 D in the concave glass. In fact, a concave glass correcting the *apparent* M. of an eye may be supposed to be made up of two parts, one of which corrects the *real* M., the other of which neutralises the amount of A. called into play. The former part is a fixed amount; the latter varies and equals the excess of strength of the glass. We cause the latter to disappear by making the excess of strength of the glass to disappear—i.e. by finding the *weakest* glass, which gives the best attainable distant vision.

To resume: the measure of M. is the weakest concave glass which gives the best attainable distant vision.

This is the most convenient test of M.; but there are others to be applied with the ophthalmoscope, which must be briefly noticed.

In looking into a myopic eye with the ophthalmoscope, the mirror being held at a considerable distance from the observed eye, an inverted image of the fundus is seen. This is formed in the air in front of the eye at its *punctum remotum*. To see it, the surgeon must be farther off the patient than this *punctum remotum*. When the observer, still having the fundus image in view, makes slight lateral movements of his head, the image moves in the opposite direction. As he approaches the patient's eye, this image gets blurred, and then disappears; when he gets the ophthalmoscope into the ordinary position for direct examination, no distinct view of the fundus is obtained unless a concave glass is used behind the mirror. The *weakest concave* glass which gives a distinct view of the fundus in this position equals the amount of M. See OPHTHALMOSCOPY.

This is only the case, however, if the eye of the surgeon be in a state of emmetropia at the moment the examination is made. If he be myopic, the amount of his M. must be *deducted* from the concave glass, in order to get the amount of the patient's M. If he be hypermetropic, and have his A. relaxed, the amount of the H. must be *added*.

In retinoscopy the shadow moves with the mirror, unless M. be of very low degree—say less than 1.50 D.

Complications.—These attend the higher grades. The most common is what is called a 'posterior staphyloma;' this is, anatomically, a bulging of the coats of the eye in the neighbourhood of the optic disc; the pathogeny of it is uncertain. It may be well marked, so as in the enucleated eye to be easily recognisable as an ovoid protuberance. It is accompanied by atrophy and irregular pigmentation of the surrounding retina. With the ophthalmoscope, it is generally seen as a crescentic patch of atrophy extending along the outer margin of the disc; as it extends it embraces still more of the disc, and may reach outwards to the macula; or further, assuming then the most irregular forms. It lengthens still more the already elongated eye, and so increases the M. when it extends to the macula, that it seriously impairs v. This patch of atrophy is known as the 'myopic crescent.'

Other complications are fluidity of the vitreous with floating opacities, detachment of the retina, and divergent strabismus.

The latter is a much rarer attendant of M. then convergent strabismus is of H.

Treatment.—Much may be done in the way of preventive treatment by securing good school arrangements, proper lighting, well-constructed desks, &c.

When M. is already developed, what may be called the hygiene of the eye should be carefully attended to. Myopic children should not be subject to educational over-pressure, should not use their eyes up to the point of making them ache; if there be much irritation or fatigue about the eyes, prolonged absence from school should be insisted upon. It is right that M. should be taken into account when the time comes for the choice of a profession.

In all cases we must prescribe well-printed books and good illumination of them. The most comfortable artificial light is a good oil lamp, well-shaded, so that no direct light falls on the reader's eyes; in writing, the lamp should be placed on the writer's left front, so that the shadow of the pen may not interfere with the view. Books or writing must be held at a good distance, and stooping avoided. Frequent rest must be given to the eyes, and if they are irritable the cold douche may be used.

The optical treatment of M. is quite easy in the *low grades*, say up to 4 D. Here, all the patient complains of is that distant vision is imperfect; he can see to read and work quite well, his far point lying beyond the distance at which this can be done with comfort. Here, the glasses that fully correct M. may be ordered.

As these are intended only for distant vision, and therefore for occasional use, they may be worn in a frame or a *pince-nez*, as the patient chooses.

They are to be worn solely as a matter of convenience, and not as being at all necessary to the well-being of the eyes. Patients often want glasses especially for music. Pianoforte music lies usually at about 20" from the eye; if M. be not greater than 2 D, the far point of the eye being in that case not less than 20", no glasses are wanted; if M. be greater than 2 D, glasses will be necessary, and the full correction may be worn.

In M. of medium grade, say 4 D up to 8 D, as a rule glasses will be wanted both for distance and for reading; the distance glasses are a matter of convenience, as in

the lower grades of the affection. But reading glasses *must* be worn; without them, the strain on the eyes caused by the excessive convergence of the visual axes necessary for reading will certainly increase M., besides giving rise to much immediate trouble, aching of the eyes, and the other discomforts that have been already spoken of as attending the higher degrees of M. The distance glasses will be the full correction as before, and if the patient be young, and A. therefore good, the same glasses may do for reading. In these cases, however, A. has so long been in abeyance prior to the use of glasses, that it cannot be expected to be so active as in an emmetrope. As a rule, however, we may at first order that the distance glasses should be used for reading also; if no discomfort ensues, they may be continued in use; if, however, they cause pain, a somewhat weaker pair must be ordered for close work. For instance, suppose a patient with $M. = 8\text{ D}$; here $R = \frac{100}{8}$

cm. (4 inches). There is no distinct vision beyond 4 inches, and, further, vision at that distance is probably irksome on account of the excessive convergence necessary to bring both visual axes to bear on the same point.

Here 8 D should be ordered for distance, and in suitable cases also, tentatively, for reading and working. As 8 D brings the eye into the condition of an emmetropic one, the amount of A. necessary for reading

at 25 cm. ($10''$) will be $\frac{100}{25} = 4\text{ D}$. Now it

is found by experience that, for continuous work, only about one-half of the full amount of A. at the disposal of an eye can be comfortably exerted. The ciliary muscle is in this respect like other muscles; it cannot exercise its full power for a long period without fatigue. The eye we are considering ought then to have 8 D of A. at its disposal, in order to read comfortably with the glasses; the table above given will show whether the patient's age is such that this amount of A. may be expected. Something also must be allowed for the fact of the eye being a myopic eye, and therefore not in the habit of using its A.

Say the patient's age is twenty. The table shows that at twenty the eye has 10 D of A.

This eye, then, will have the necessary amount of A. (8 D) for continuous reading, and still a reserve of 2 D . This may be called, then, a suitable case for ordering, experimentally, the full correction for both

distant and near use. If after a week or two's trial the glasses cause pain, a weaker pair may be ordered for reading; the deduction commonly made is 2 D , so that we should now prescribe -6 D for reading, the full 8 D being still used for distance. In wearing -6 D for reading at 25 cm. ($10''$) what demand is made on A.? We have seen that with the full correction -8 D , 4 D of A. is wanted; with -6 D , only 2 D of A. will be required. The eye ought then to have a total $A. = 4\text{ D}$, or rather more as it is a myopic one, say 5 D . Now, the table shows that A. does not reach so low a stage as 5 D till the age of 40 is approached. Hence, up to this age the glasses above suggested may be expected to suit the patient. Or, it may be advisable to order the glasses in a different way; if the patient's occupation be principally about things that lie near him, the weaker glasses may be used pretty constantly, and when very distinct distant vision is wanted, additional glasses that represent the difference between these weaker glasses and the full correction (in the above case -2 D) may be held up in a *pince-nez* before the other glasses in a frame.

The same rules apply to the higher grades of M. above 8 D . They must, however, be taken as only suggesting the principles to be followed. In no other affections of the eye is it more necessary to treat each case on its own merits.

It is principally in these high grades of M., but to some extent in the medium grades also, that all the discomforts described above are found. V is here nearly always much impaired, on account of changes in the fundus; the glasses necessary to remove the far point to a safe distance diminish the retinal images, and still further impair v. The patient is then tempted to hold his work near again, and then all the evil results of excessive convergence again ensue. If the struggle for binocular vision is given up, and one eye remains in a condition of divergent squint, the patient is often in a better condition. The diverging eye, it is true, suffers and may become amblyopic, but the other one is more comfortable. In addition to the best optical aid that can be given, all the hygienic measures recommended as general treatment should be put into force; if M. be rapidly increasing, and the symptoms of irritation severe, complete rest must be insisted upon, and the eye well protected from light; further treatment might consist in the use of flying blisters on the temples, or even occasional wet cupping with Heurte-loup's artificial leech.

(b) HYPERMETROPIA.—Here parallel rays come to a focus behind the retina. This is due to a disturbance of the normal relation that exists between the length of the eye and its refractive power. Actually, it is generally the case that the axis of the eye is too short; we shall, however, consider it as being due to a *decrease* in the refractive power of the eye, just as we considered M. to be due to an *increase* in this power. We may imagine that in H. we have an emmetropic eye armed with a concave lens in front of it. The strength of this lens will be a fair measure of H., since it represents the departure from the emmetropic eye.

Let us examine the peculiarities of vision in H., and suppose, for example, we have an eye with H. = 6 D.

This is equivalent to an emmetropic eye with a lens -6 D in front of it. Now this lens will make parallel rays to proceed as if they diverged from its principal focus—i.e. from a distance $\frac{100}{6}$ cm. in front of it.

These rays falling on the emmetropic eye, which we have imagined combined with the concave lens to form the hypermetropic eye, will not be focussed on its retina; only an emmetropic eye can focus parallel rays on its retina while the accommodation is at rest. Hence, distant objects, from which such parallel rays emerge, will not be seen distinctly by the hypermetropic eye. Still less will near objects be seen distinctly. The only rays that can be focussed on the retina in this case are rays which are parallel after having passed the hypothetical concave lens, and which therefore are converging virtually to its principal focus—i.e. to a point $\frac{100}{6}$ cm.

behind it. But the rays which proceed from all objects are divergent rays; hence, the hypermetropic eye, being able to focus on its retina only convergent rays, cannot (unassisted) see any external object distinctly. This is only so long as it remains at rest. When it calls into action its accommodative power, which, as we have seen, is equivalent to placing a convex lens in front of it, it can not only neutralise the hypothetical concave lens which represents its H., and so see distant objects distinctly, but, by a further tension of A., it can adapt itself for divergent rays, and so see near objects plainly. Suppose the above eye, for instance, in which H. = 6 D belongs to an individual ten years old. At ten our table shows that the total A. = 14 D. By exerting 6 D of his A., then, this person neutralises his

H., and brings his eye into the position of an emmetropic one, and has still 8 D of A. in reserve.

In this condition he sees distant objects distinctly. If he wishes to see near objects, he makes a further demand on his A., the amount depending on the distance of the object. Suppose the object is at 25 cm.

(10'') from the eye: a convex lens of $\frac{100}{25} = 4$ D

at the eye would make rays diverging from the object parallel, and therefore in a condition to be focussed on the retina of the eye, which by using 6 D of its A. is already in a condition of emmetropia; the additional call upon A. then = 4 D, and the total amount of A. required by this hypermetropic eye for seeing distinctly at 25 cm. is 10 D. Will this eye be able to work for long at this distance? No; we have seen above that, for continuous work, not more than half A. must be in use; here 10 D—the whole of A. being 14 D—is in use. The eye, then, if called upon to work for long at this distance, would tire. An emmetropic eye, on the contrary, at the same age, having 14 D at its disposal, and not requiring to use any of this to correct any H., would want only 4 D out of the 14 for working at this distance, and would therefore do it easily. This fatigue of the eye on working is the type of the complaints of the hypermetrope.

Etiology, &c.—H. is always congenital, and never increases in after-life except slightly in old age; it may diminish, and even change into M., owing to elongation of the eye. After removal of the lens in the operation for cataract, a high grade of H. is produced owing to loss of refractive power: this is called aphakia. The amount of H. varies within wide limits; 2 or 3 D is a very common amount; 8 D would be thought a highest degree; in aphakia in an originally emmetropic eye H. equals about 10 D. The amount of H. in the two eyes is usually nearly the same.

Symptoms.—In low degrees there are often no symptoms till the patient approaches middle life; then, several years before people usually want spectacles, he comes with the usual complaints of presbyopia; cannot see to read, especially by artificial light, &c.

The age at which these symptoms occur depends on the amount of H. and the distance from the eye of the habitual work. At the age of thirty, for instance, total A. = 7 D, and therefore 3.5 D can be exerted continuously.

Now, for continuous work at 40 cm. (16") an emmetropic eye requires $\frac{100}{40} = 2.50$ D

of A. Suppose the person of thirty years of age has 1 D of H., then 1 D of his 3.5 of available A. will be used up in correcting the H., and the remainder 2.5 D will just suffice for continuous work at 16". Such a person would in a year or two probably need spectacles for his usual work.

In the higher degrees, even young people suffer much. Often the break-down of the general health determines the onset of the symptoms. In very high degrees M. may be simulated: distinct images being in no way attainable, objects are held very close so as to get large retinal images, and hence the patient is supposed to be short-sighted. In old people who have never worn glasses, and have a considerable amount of H., vision for near and distant objects may be so defective that the surgeon may, if he neglect to try the effect of convex glasses, diagnose some serious nerve-affection.

Diagnosis and Measurement.—The complaints of the patient usually indicate pretty clearly what is the matter. His 'eyes are weak'; close work soon tires him; the letters run into one another, get dim, &c.

We now proceed to test v in the usual manner, trying each eye separately, and both with near types and distant.

If v for distant objects be improved, or even not made worse by a convex lens, it is a case of H.

The amount of H. is given by the *strongest convex* lens which gives the best attainable vision at 6 mètres. It must be the *strongest* convex lens, in order to secure the complete relaxation of the accommodative power. Contrast this with the rule for M.; there it was the *weakest concave* lens which gave the best attainable vision at 6 mètres. A short consideration analogous to the one set out in the case of M. will show the reason of the rule in H.

There is, however, a difference in the case of H. Here, as we have seen, some amount of A. is always in play, even for distant vision, and a considerably larger quantity for near vision. The result of this is that the ciliary muscle gets into a condition of spasm, and will not relax when its continued contraction is no longer wanted, nay even is injurious to distinct vision.

Suppose H. = 4 D, and that glasses have never been worn; here 4 D of A. has always been in use for distant vision, and 7 D or 8 D

for near vision. In testing the eye now with the types at 6 mètres, probably $v = \frac{6}{6}$ without any lens at all, the 4 D of A.

being in action; 1 D is put up in the trial frame; as the eye will bear only +4 D in front of it for distant vision, 1 D of A. must

be relaxed if v is to remain $= \frac{6}{6}$. Suppose

v remains unimpaired, +2 D is now put up in the trial frame; if v is now to remain $= \frac{6}{6}$, another 1 D of A. must be relaxed.

If now the ciliary muscle be in the condition of spasm, it may refuse to relax this additional 1 D, even though strongly solicited to do so by the desire of the eye for distinct vision. If it do not so relax, 1 D would be the strongest convex glass that gave the best attainable vision at 6 mètres, and so 1 D would appear to be the amount of H., whereas H. is really = 4 D. In such a case as this, the total amount of H. would probably only appear when atropine or some such agent was used to thoroughly relax the ciliary muscle. The total amount of H. revealed after the prolonged use of atropine is called H. totalis (H. t.); the amount of H. that reveals itself when convex glasses and no atropine are used is called H. manifesta (H. m.); the difference between the two is called H. latens (H. l.). A small amount of H. l. is always present; it is only when it exceeds 2 D or 3 D that this formal distinction between H. t. and H. m. is made. When H. is written unqualified, H. m. is meant.

Ophthalmoscopic Tests.—In looking into a hypermetropic eye with the ophthalmoscope, at a considerable distance from the observed eye, a real image of the fundus is seen. This does not disappear as the patient is approached. When slight lateral movements of the surgeon's head are made, the image of the fundus moves in the *same* direction. When the surgeon gets the ophthalmoscope into the ordinary position for direct examination, the image is still plainly seen, and continues clear when convex glasses are used behind the mirror. The strongest convex glass with which the fundus can be distinctly seen is a measure of the H. (if the surgeon be himself emmetropic).

In retinoscopy the shadow moves against the mirror. It does so also in low M.

Complications.—The only one that need be mentioned is concomitant squint, which is nearly always convergent. See STRABISMUS.

Treatment.—This is simple and very successful. In ordinary cases it is enough to give glasses that neutralise the H.m.

If after a time there should be pain with these, the existence of a considerable amount of H.l. should be suspected. To get at once to the bottom of the case, atropine should now be ordered, and H.t. found. If this differ much from the H.m. originally found, fresh glasses should be ordered. These should be about 1 D weaker than the full correction, to allow for the inevitable slight spasm of accommodation, which will come on as the effect of the atropine wears off.

These glasses need generally be worn only for close work.

In high grades of H. it is best to give the full correction, and order the glasses to be worn constantly. This is especially desirable in children.

In the case of old people, two pairs will be wanted—one for distant vision and one for near work; or even intermediate pairs may be needed, if distinct vision is desired at intermediate distances.

It will be useful here to contrast the diagnosis of M. and H.

In M. distant v is *improved* by a $-ve$ glass.

In H. distant v is *not made worse* by a $+ve$ glass.

In M. the retinal vessels move *against* the observer.

In H. the retinal vessels move *with* the observer.

In M. the retinoscopic shadow moves *with* the observer (generally).

In H. the retinoscopic shadow moves *against* the observer.

The amount of M. is the *weakest concave* glass which gives the best attainable distant vision.

The amount of H. is the *strongest convex* glass which gives the best attainable distant vision.

The amount of M. is the *weakest concave* glass with which the fundus can be distinctly seen by the direct method.

The amount of H. is the *strongest convex* glass with which the fundus can be distinctly seen by the direct method.

A few cases are here given to illustrate the method of testing and noting the vision:—

Case 1.—Low M. The patient, a woman, thirty years of age, complains of being near-sighted. On testing the eyes it is found

$$\text{R. E. } v < \frac{6}{60}; \text{ with } -3 \text{ D} = \frac{6}{9};$$

no improvement with cylinders.

J. i. at 30 cm.

$$\text{L. E. } v < \frac{6}{60}; \text{ with } -3.30 \text{ D} = \frac{6}{9};$$

no improvement with cylinders.

J. i. at 30 cm.

Here -3 D was ordered in a *pince-nez* for distant vision; the eyes being used unaided for reading.

Case 2.—High M. The patient, a carpenter, aged thirty-four, complains of not being able to see his work. Examination reveals—

$$\text{R. E. } v < \frac{6}{60}; \text{ with } -9 \text{ D} = \frac{6}{18}.$$

J. i. at 12 cm.

$$\text{L. E. } v < \frac{6}{60}; \text{ with } -9 \text{ D} = \frac{6}{12}.$$

J. i. at 12 cm.

On trial it was found that with -7 D he could read J. i. at a fair distance, and the same glasses gave $v = \frac{6}{24}$. As he was

satisfied with this amount of distant vision, he was ordered only one pair of glasses, -7 D for constant use.

The above form of noting the result of the visual examination will be found a convenient one. Where v at 6 mètres does not come up to $\frac{6}{60}$, the patient might be

brought up to the types till he could see the largest—viz. 60, if an exact numerical expression were desired for v ; in most cases it is enough to note that v is less than $\frac{6}{60}$; this is commonly written $v < \frac{6}{60}$.

Case 3.—Low H. Patient, a woman of twenty, complains that she cannot see to work at night.

$$\text{Here R. E. } v = \frac{6}{6}; \text{ with } +2 \text{ D, } v \text{ still} = \frac{6}{6};$$

therefore H. = 2 D.

J. i. 8''–12'' (8'' the near point, 12'' the far point).

$$\text{L. E. } v = \frac{6}{6}; \text{ H.} = 2.50 \text{ D.}$$

J. i. 8''–12''.

In this case $+2.50$ worn for work gave complete relief.

Case 4.—High H. The patient, a girl of twelve, was brought with the complaint that she was *short-sighted*. It was found, however, on examination, that it was one of the cases of H. simulating M.; in fact, after atropine, it was found—

R. E. H. = 9 D; and with + 9 D, $v = \frac{6}{18}$.

L. E. = 10 D; with + 10 D, $v = \frac{6}{18}$.

She was ordered + 8 D for both eyes, an allowance of 1 D being then made for the effect of the atropine; these were to be worn constantly. After a few months with the glasses,

R. E. $v = \frac{6}{9}$; L. E. $v = \frac{6}{18}$.

The refracting surface of the eye has hitherto been supposed spherical, so that the image of external point on the retina was either a point or a circle of diffusion; there are, however, many eyes in which the surface is not spherical, so that different meridians of this surface have different curvatures.

This condition of the eye is called **ASTIGMATISM**. It is divided into regular and irregular.

The *irregular* is generally due to some disease of the cornea, which has so distorted it that it is no longer any definite mathematical surface at all. It is seldom susceptible of any optical help, and will not be further alluded to here.

In *regular astigmatism* the surface is formed according to definite laws. There is one meridian of greatest curvature; another, at right angles to the first, of least curvature; and the intermediate ones are of intermediate curvature. These meridians are all nearly circular. The meridian of greatest curvature is generally vertical. To save space, it will, in what follows, be supposed that it is always so, and, consequently, that the meridian of least curvature is horizontal. In considering the refraction of rays by an astigmatic surface, we find that the image of an external point is a short horizontal *line* at the conjugate (to the external point) focus of the vertical meridian, and in the neighbourhood of this focus the image is a horizontal *oval*; at the conjugate (to the external point) focus of the horizontal meridian, the image is a short vertical straight line, and in the neighbourhood of this focus a vertical oval; midway between these two foci the image is a circle.

Now, suppose we have a straight line external to the eye; call this *AB*, and first suppose it to be vertical. Further, let us call the focus of the vertical meridian F_v ; that of the horizontal meridian F_h ; this line may be supposed made up of a series of points, arranged vertically over one another.

At F_v the image of each of these points is a short horizontal straight line, and therefore the image of *AB* a series of horizontal straight lines, parallel to one another and placed side by side; the image of *AB* is then a faint, wide vertical stripe.

At F_h , on the contrary, the image of each point of *AB* is a short vertical straight line, and therefore the image of this external vertical straight line a series of short vertical straight lines which overlap one another; this image, then, is a thin, well-defined vertical line. Now, suppose *AB* a little inclined to the vertical. Each point of it will, as before, have a short horizontal straight line for image at F_v ; but these lines do not now lie directly over one another, but are arranged like the steps of a steep staircase, and they overlap one another a little; the image of *AB* at F_v is then a stripe parallel to it, and rather more defined than when it was vertical.

At F_h the series of short vertical straight lines, which are the images of the points of *AB*, overlap, but not so directly as they did when *AB* was vertical: the image of *AB* at F_h is then a stripe parallel to it, and rather less defined than when it was vertical.

Hence, if *AB* in its new position slightly incline to the vertical, at neither F_v nor F_h is a clear image formed; still less is the image clear at intermediate points between F_v and F_h , where the image is formed by a series of overlapping, horizontal, or vertical ovals, instead of horizontal or vertical straight lines, as at F_v or F_h .

As *AB* departs more and more from the vertical its image at F_v becomes more distinct, its image at F_h less distinct; until it becomes horizontal, when at F_v there is a perfectly distinct image formed, whilst at F_h the image is very indistinct.

Hence, when the two chief meridia of the eye are vertical and horizontal, of only two external straight lines are clear images formed, and these are the vertical, of which a clear image is formed at F_h , and the horizontal, of which a clear image is formed at F_v . If we now suppose the retina of the eye situated at F_h , only vertical lines will be seen quite distinctly: other lines will be seen with increasing indistinctness the more they depart from verticality, and horizontal lines will be the most indistinct of all.

If the retina be at F_v , just the reverse of this will be the case—i.e. horizontal lines only will be seen distinctly, others with varying indistinctness; whilst if the retina

be situated neither at F_h nor F_v no lines will be seen distinctly.

Now, the human eye has the power, by means of its accommodation, of making the position of the retina coincide with either F_v or F_h , or occupy intermediate positions. Hence, generally an astigmatic eye can see distinctly lines parallel to its two chief meridians; not simultaneously, however, but by two different efforts of its accommodative power. But it has no power of seeing distinctly lines in other directions. As the contours of objects are made up generally of lines running in an infinite number of directions, it is easily imagined how indistinctly such objects are seen by an astigmatic eye.

At any given moment, the eye sees distinctly only the outlines of an object parallel to a certain line; by an effort of its ciliary muscle it can so alter its refractive power as to see the outlines running in a direction perpendicular to the first. Probably, an astigmatic eye is thus continually altering its accommodative tension, so as to get clear outlines in two directions of each object that is successively presented to it. This continual change of strain of the ciliary muscle accounts for much of the fatigue from which such eyes suffer.

Regular astigmatism is divided into five varieties; (1) if, A. being relaxed, both chief meridians are myopic—it is called compound myopic astigmatism; (2) if one meridian be myopic, the other emmetropic—it is called simple myopic astigmatism; (3) if one meridian be emmetropic, the other hypermetropic—it is called simple hypermetropic astigmatism; (4) if both meridians be hypermetropic—it is called compound hypermetropic astigmatism; and (5) if one meridian be hypermetropic and the other myopic—it is called mixed astigmatism.

Etiology. — Regular astigmatism is nearly always congenital. After operations on the cornea, however, a considerable amount of regular astigmatism is often seen. It is generally nearly equal in amount and symmetrical in the two eyes. High degrees of M. or H. are nearly always complicated with astigmatism. It often runs in families.

Cylindrical Lenses.—The difference in curvature between the two chief meridians may be corrected by a cylindrical glass. This has no curvature—is plane parallel to its long axis; in the meridian perpendicular to this may be ground to any curvature; whilst the intermediate meridians have intermediate curvatures. The correction of the accompanying M. or H. is of

course made by a spherical glass, on which the cylinder can be ground. Generally, the sphere is given which corrects the meridian of greatest curvature in H., or least curvature in M.; this accordingly must be combined with a negative cylinder, strong enough to correct the other meridian. A cylindrical lens has no refractive effect in a meridian parallel to its axis, and this accordingly in the correcting glass, if a negative cylinder be used, must be placed parallel to the meridian of greatest curvature in H. or of least curvature in M. Suppose, for example, in vertical meridian M. = 6 D, in horizontal meridian M. = 4 D; then a $-ve$ sphere = 4 D would be given, combined with a $-ve$ cylinder = 2 D, with its axis horizontal.

It would come to the same thing if a $-$ sphere = 6 D and a $+ve$ cylinder = 2 D, with its axis vertical were given.

Diagnosis and Measurement.—The complaint is generally of 'weakness of the eyes,' so that at first we do not know that it is not a case of simple M. or H. When, however, with the best spherical glass v is considerably below the standard $\frac{6}{6}$, astig-

matism may be suspected. This is especially so in the case of H., where degenerative changes in the fundus are relatively rare. The diagnosis can often be made with great certainty by holding up in front of the eye, already armed with the sphere (+ or $-$) that gives the best v at 20', a weak $-ve$ cylinder, say, -1 D cyl.

If this be held with its axis parallel to the meridian of least curvature, it will almost certainly improve v . Now this meridian of least curvature is, in most cases, horizontal or nearly so.

We hold this weak cylinder, then, with its axis horizontal, and see if v is improved thereby; if not, we slowly rotate it in front of the eye through a complete half-circle, asking the patient if there is any improvement of v in any position. If not, there is no astigmatism. If there is, the position of the axis that gives the best v is the meridian of least curvature of the eye, and the other chief meridian is of course perpendicular to this. We then hold up stronger $-ve$ cylinders with axis in the same position. The weakest cylinder that gives the best attainable v is the measure of the astigmatism.

In this way many cases can be quickly tested both qualitatively and quantitatively.

There are many other tests for astigmatism, both subjective—i.e. depending on

the answers of the patient like the above, and objective. Of the objective the only one we shall refer to here is RETINOSCOPY. A complete discussion of this method will be found under this heading.

In many cases of astigmatism, a satisfactory result cannot be got without using a mydriatic. This may be either atropine, of which a solution gr. ij. ad fʒj. may be used three times a day for three or four days; or homatropine, a solution of the same strength for three or four times. The atropine completely paralyses the ciliary muscle, and so makes near vision (except in certain grades of M.) very dim. This effect passes off in about a week or ten days. The homatropine does not suspend the accommodation so completely as atropine; but the effect passes off much more completely than that of the other drug; generally, accommodative power is fully restored in twenty-four hours. It may be used as a substitute for atropine, when the patient cannot submit to the week's dimness of sight the latter generally causes.

The vision is to be tested whilst the eyes are fully under the influence of the drug; an interval is then to be allowed for them to recover (say ten days for atropine, two days for homatropine), and then the glasses ordered which give the best v in this condition. These will generally be found to differ from the best glasses under atropine in being about 1 D weaker, this being the usual amount of the tonic spasm of A. before referred to. If there be a great difference between the refraction with and without atropine, glasses 1 D weaker than those giving the best v under atropine should be given for constant use as soon as the atropine is discontinued. It may be asked, why use atropine at all, if glasses are to be finally ordered adapted to the non-atropinised state? The answer is, partly to provide for these cases of excessive spasm, partly to facilitate the objective examination.

In any case where strong glasses are ordered, either spherical or sphero-cylindrical, the patient must expect a few weeks' discomfort till the eyes get accustomed to working under the new conditions. They should be worn continuously and perseveringly. Children adapt themselves much more readily than adults to such glasses.

A case of astigmatism is subjoined:—

Case 5.—As. The patient, an architect, aged twenty-two, suffers from headache all day. This he attributes to wearing impro-

per glasses. These he has used constantly for the last twelve months; they are R.E. — 6.50 D, L.E. — 5.50 D. Tested R.E. $v < \frac{6}{60}$; with — 7 D spher. \bigcirc — 3 D cyl., axis 80° up and in from vert. $= \frac{6}{9}$. L.E. $v < \frac{6}{60}$; with — 5 D spher. \bigcirc — 2 D cyl., axis 80° up and in from the vertical $= \frac{6}{9}$.

He was ordered these for constant use, and had no further trouble. The symbol used above after spher. (spherical) denotes 'combined with.' The direction of the axis may be indicated as above, or, better still, by a diagram.

Another *error of refraction* must be referred to. This is ANISOMETROPIA. This term is applied where there is a considerable difference between the refraction of the two eyes. Small differences are common enough in M. and As.; it is only when the difference reaches say 2 or 3 D that anisometropia is spoken of. It is often very difficult to treat if the difference be considerable. In slight cases each eye may be fully corrected, or else the correction adapted to the less ametropic of the two ordered. Sometimes the medium correction answers best; but each case must be treated on its own merits. Occasionally, where one is M., the other Em. or H., the former is habitually used for near work, the latter for distance, and no discomfort felt.

It remains to speak of *spectacles*. The fitting of these may generally be left to the optician; but the surgeon should satisfy himself that the glasses have their centres opposite the patient's pupils, unless it is otherwise desired, and that they are of the strength ordered. To test any given lens, a test glass of its alleged focal power but of opposite denomination—i.e. +^{vx} or —^{ve}, according as the lens to be examined is —^{ve} or +^{vx}, is held in contact with it, and the two held close to the surgeon's eye and moved rapidly from side to side. If the test glass now exactly neutralise the other, any distant object—say the window-bars—seen through the combined glass remains stationary. If the combination is +^{vx}, it moves in the opposite direction, if —^{ve} in the same direction.

Patients often ask if they should have pebbles. These have no optical advantage over crown glass, and are much more expensive. Sometimes reading glasses require to be tilted forward at an angle of 10° or 15°—'angled,' as it is called. This is to be indicated in the prescription. The form a

prescription commonly takes is the following:—

[Patient's name.]

Glasses for reading:

+ 3 D

[Surgeon's name.]

or, in more complicated cases—

[Patient's name.]

Glasses for constant use:

Right eye: + 2 D spher. \bigcirc - 4 D cyl., axis 30°
from vertical up and out.

Left eye: + 2 D spher. \bigcirc - 3.50 D cyl.,
axis 20° from vertical up and out.

[Surgeon's name.]

If any particular form of frame or colour of glass, such as neutral tint, be required, proper directions will have to be added to above.

W. CHARNLEY.

REGNOLI'S OPERATION. See
TONGUE, Operations for Removal of the.

RENAL CALCULUS. See NEPHROLITHIASIS.

RENAL COLIC is a term employed to describe a train of symptoms, due to the sudden stoppage of the ureter by some foreign body passing down its lumen, or to some morbid condition of its own walls. The onset is nearly always sudden, the most prominent symptom being pain, usually of a very severe kind, due, on the one hand, to the great sensibility of the ureter, and, on the other, to its own efforts to dislodge the intruding mass by virtue of its involuntary vermicular action. The duration of this pain is determined, first, by the accumulation of fluid behind the obstruction, and by the size and shape of the foreign body, and then by the strength of the muscle-fibres of the ureter. Fortunately, it does not usually last long, the mass either being forced onwards into the bladder, or the ureter becoming more or less accustomed to its presence. The causes of obstruction of the ureter, and consequent renal colic, may be the passage of—(1) a calculus, (2) a blood-clot, (3) a caseous shred of tubercular matter, (4) hydatids, (5) a portion of new growth, (6) the presence of a tubercular ulcer in the tube.

The *symptoms* in an ordinary attack are, usually, as follows. An agonising sickening pain sets in, usually with great suddenness, in the renal region, and radiates from this down the track of the ureter into the genitals and inner part of the thigh. With this there is often faintness and even vomiting, the patient probably at the same time breaking out into a cold sweat all over the body. When the first faintness has passed off,

he will probably bend and twist the body nearly double with suffering, and endeavour to relieve himself by contortions in all directions. There will also be, in the male, most likely a retraction of the testicle. In some cases, the temperature is raised, and the pulse becomes rapid and feeble. Then, after a period, usually measured by hours, there is a complete cessation of the pain, as sudden as its onset, and a disappearance of the other troubles as well.

The *diagnosis* is based, first, upon the previous history of the case—i.e. if the patient has passed small calculi or 'gravel' before, or has had attacks of hæmaturia, or evidence of tubercular disease, parasites, or new growth in the kidney. Again, if there has been hæmaturia and the ureter is stopped by blood-clot, the water, previously blood-stained, will be passed clear during the colic, to return to its former red colour with the cessation of the pain, at the same time that small, worm-like clots are passed with the urine *per urethram*. In the same way a small calculus may be passed.

The paroxysms of pain, with which renal colic is most likely to be confounded, are (1) ordinary colic, (2) the passage of biliary calculi, (3) sudden obstruction of the urethra by blood-clots, stone, or new growths. From the first of these it will be distinguished by the seat of the pain and suddenness of the onset, usually after some renal symptom; by the absence of constipation, and then by percussion, which will probably indicate the condition of the intestine. Palpation, too, will often detect the painful spot in the flank where the obstruction of the ureter has taken place, and may even make out the foreign body. From biliary colic a distinction is made by means of the history, the seat of the pain, and in some cases by the occurrence of jaundice. Blood-clots, stone, and new growths in the bladder, leading to sudden obstruction of the urethra, can be demonstrated by the introduction of a catheter or sound, as well as diagnosed from the clinical history.

The *treatment* of renal colic varies with the cause, and resolves itself into palliative and curative. Under the first head will come, rest in the recumbent position, hot belladonna fomentations over the whole side, and the repeated injection of morphia in free doses hypodermically. In the case of blood-clots, calculi, or tissue-shreds, free kneading and manipulation over the track of the ureter, in the hope of assisting the passage of the foreign body into the bladder, may be tried. See NEPHROLITHIASIS; NEPHROLITHOTOMY.

ARTHUR E. BARKER.

REST.—‘The first and great requisite for the restoration of injured parts is rest,’ was John Hunter’s epoch-making generalisation. Than that, no proposition is more worthy of the surgeon’s thought, none more fertile for his patient’s good. The principle of constitutional and local rest is so interwoven with the whole teaching of this work, that it would be impossible to do it separate justice without time-wasting recapitulation. Yet, as one of those fundamental truths which cannot be inculcated too often or too impressively, an endeavour to methodise some of the most conspicuous advantages of rest may be justified by practical convenience and usefulness.

As movement increases the heart’s action and is opposed to blood-coagulation, so this is favoured, and that retarded, by rest. Hence the value of rest in the treatment of disease and injuries of the blood-vessels, in wounds and aneurisms.

To quote from Mr. Hilton’s classical lectures on ‘Rest and Pain,’ ‘growth and repair have an exact relation to due physiological rest, local and general.’ Accordingly, the repair of solutions of continuity in all tissues, hard and soft, proceeds in closest conformity to the physiological standard and with the minimum risk of pathological complication, the more perfectly divided parts, once re-adjusted, are maintained in a state of absolute repose. On this principle is based the sound practice of infrequent wound-dressing, and of treating broken bones and acute articular affections by immobilising the joints above and below, as well as the seat of mischief.

Mechanical and physiological, constitutional and local, medicinal and manual resources, such as darkness and mental quiet, anæsthetics, opium and allied preparations, position and suspension, cold and pressure, are all, in appropriate proportion, powerfully contributory to rest and repair. Once more experience teaches the great lesson, that complexity in the causation of pathological states necessitates combination of therapeutic resources for purposes of relief and cure.

Rest is something more than a mere negation of motion, as illustrated by the apparently, but not really, simple case of an irritable ulcer on the swollen leg of a big-bellied person. In such a patient, rest in the recumbent posture, and suspension of the foot soon give temporary ease; but recovery is greatly favoured by elastic pressure of the limb, and by administering a brisk purge, which may often be advantageously followed up with opiates. The

constitutional and local rest combine in relieving vascular and nerve tension, and favouring healthy nutrition. In anal fissure and fistula, healing is prevented by the contractility of the very sensitive and active sphincter muscle. Divide as much of it as is necessary to insure rest in the particular case, and healing proceeds painlessly and solidly. The pain occasioned by foreign bodies, such as a thorn in the finger, a fish-bone in the throat, or a stone in the bladder, or by a dislocated or broken bone, ceases with the removal of the cause of unrest, be it extraction of the foreign body or restoration of the displaced part to its normal relations. So with the vomiting and pain due to strangulated hernia. Injuries of the chest and abdomen supply further illustrations in point. In such cases rest in the recumbent posture affords great, but not complete, relief. Where several ribs are broken, with or without wound of the soft parts, the chest requires good padding and abundant bandaging with equable pressure. A lattice-work of millboard, or other mouldable splintage, contributes powerfully to comfort; and so does fixing the arm, to rest the pectoral and dorsal muscles completely, on the injured side. Opium is additionally useful; the medicinal and mechanical treatment combining to reduce the number of respirations, and to favour abdominal breathing, during fixity, rest, and repair of the chest-wall. When the abdomen is bruised or wounded, rest is promoted by sedatives, by resting on the back with the shoulders raised and the thighs flexed, equable pressure being at the same time applied over the abdominal wall. Such pressure may be very beneficially practised, according to the requirements of particular cases, by broad bandages over good padding; or by means of a heavy poultice, or a shot mattress; a sand, water, or ice bag.

In painful cases of retention of urine, when ineffectual attempts have been made to pass a catheter, an anæsthetic may render easy what was before impossible. That failing, opium pushed judiciously to its full action, as indicated by contraction of the pupils, often succeeds in lulling pain, relaxing spasm and congestion, and allowing the urine to dribble, and, by-and-by, to flow. When, in such a case, anæsthetics, the catheter, hot hip-bath, purgatives, and opium all fail, and the bladder can only be saved from threatened rupture by suprapubic aspiration or tapping *per rectum*, urine often flows with comparative freedom *per urethram* once engorgement and spasm of

the passage are relieved by a few hours' rest after the operation. These are only a few illustrations of the value of the great therapeutic principle of rest; the reader interested in its further applications may refer to the articles IMMOBILITY; POSITION; PRESSURE; SUSPENSION; WOUNDS, treatment of
SAMPSON GAMGEE.

RETENTION OF URINE.—When the bladder contains urine which it cannot expel, retention is said to exist.

Causes.—I. *Obstructions.*—(1) Imperforate prepuce. (2) Inflammation of the urethra. (3) Abscess in the prostate, penis, perineum, or about the rectum. (4) Stricture of urethra. (5) Hypertrophy and other tumours of the prostate. (6) Calculus. (7) Tumours of the bladder, of the urethra, and of the penis. (8) Pelvic tumours. (9) Foreign bodies in the urethra, bladder, or rectum.

II. *Direct or Indirect Interference with Nerve-supply of Muscles concerned in Micturition.*—(1) Disease or injury of the cerebro-spinal axis. (2) Hysteria. (3) Drugs. (4) Wounds and contusions of bladder or urethra. (5) Surgical operations in neighbourhood of bladder. (6) Urethral spasm.

Symptoms.—The chief sign is a distended bladder, shown by hypogastric dulness on percussion, or felt by the finger in the bowel or vagina. The patient generally complains of painful and urgent desire to pass water, with constant attacks of straining, called 'spasms.' Sometimes, during a spasm a little urine is passed, giving temporary relief, while frequently the bowel itself and piles, if present, are protruded, and the contents of the rectum evacuated. These urgent symptoms may be more or less absent, sometimes almost entirely so, and the medical man must ever be on his guard, and take care that he does not overlook a chronically distended bladder, for such oversight may lead to disastrous consequences. The cause of the retention will usually be obvious enough; but it is well to remember the following points:—(1) If under fifty years of age, the patient cannot have prostatic hypertrophy. (2) If he is over fifty, and with no history of stricture, the cause is probably prostatic. (3) If under fifty, he may have stricture and never know it, until seized with retention. (4) Should the obstruction be beyond six inches from the meatus, the case is not one of stricture.

Treatment.—Immediate relief is demanded. Usually, the patient is in great pain, and the longer the distended bladder is unrelieved the less likely is it to regain

its entire contractility. A more remote danger is rupture of the urethra or bladder, with extravasation of urine. A hot bath and an opiate may be taken, or a little chloroform inhaled, and perhaps some urine will be expelled; but usually it is well to resort at once to the catheter. To prevent or mitigate the urinary fever which frequently comes on within the first few hours after catheterism, the patient should be at once put to bed after the operation, and if his urine is healthy, an opiate should be administered (liq. opii sed. ℥xv.), and washed down by some warm demulcent drink. The use of catheters in retention of urine may be considered under the following headings:—(1) Nervous retention, (2) inflammatory retention, (3) calculi in urethra, (4) urethral stricture, (5) hypertrophy or other enlargement of the prostate.

(1) *Nervous Retention.*—Here, retention has occurred although the urethra is perfectly healthy. Either the bladder cannot act from temporary or permanent paralysis or from over-distension; or reflex nervous irritation has produced 'spasm' of the urethra, this occurring when retention follows amputation of the thigh or operations for piles or anal fistula. The simplest catheter is one of vulcanised india-rubber, about No. 7 (Eng.); if this cannot be passed, a soft French coudée or olivary catheter may be attempted; if necessary, an English gum or a silver catheter must be used.

Hysterical retention almost always occurs in women. At first, judicious indifference is best; but the case may become serious if altogether neglected. After a safe interval has elapsed, a soft gum or india-rubber catheter should be introduced, and the bladder relieved. If catheterism in any particular case is undesirable, the patient may be placed in a hot hip-bath, and a jug of cold water suddenly thrown over the back, which will often produce the desired effect. See FEMALE CATHETER.

(2) *Inflammatory Retention (Gonorrhœa, Prostatitis, Abscess).*—It is well to try to avoid the use of a catheter. The patient should be put into a very hot sitz-bath and encouraged to pass water while there. If he cannot do so he may be put to bed, and the perineum freely leeches. An anodyne draught may be given if there is much pain. A brisk purge may prove useful. If these remedies fail, then a No. 7 (Eng.) warmed, oiled, soft tapering French olivary catheter may be gently introduced. If this instrument will not pass, a No. 4 or 5 English gum catheter without a stylet may be tried. A silver catheter is rarely necessary, but

when its use has been determined upon, it will be well to administer an anæsthetic, if facilities for doing so are at hand; especially if much difficulty has been encountered, owing to the swelling of the parts or the unruliness of the patient. If the retention is due to prostatic abscess, the passage of the catheter may be followed by a flow of matter, the abscess having ruptured into the prostatic urethra.

(3) *Calculi in Urethra*.—A small English gum catheter can nearly always be inserted between the calculus and the wall of the urethra into the bladder, and the retention relieved. If the calculus is at the neck of the bladder, it may readily be pushed back into the bladder by a large blunt-ended bougie or catheter. If the stone is in the penile urethra, it may generally be easily removed by the long urethral forceps or urethral scoop. *See* STONE IN THE URETHRA.

(4) *Stricture Retention*.—If, from the symptoms and history of the patient, stricture is suspected, he should be desired to make, if possible, a little water. He may not prove able to make any or more than a few drops; or perhaps a little stream of water will issue. In this case, the size of the stream must be carefully noted. Next, a No. 8 or 9 blunt-ended gum bougie or catheter should be gently passed as far as it will go. This will give a general idea of the situation of the obstruction.

If it is a case of stricture, the instrument will be arrested before it has traversed the first five or six inches of the canal. If the patient has been unable to make water, or can only make it in drops, then the smallest gum elastic catheter must be employed—a No. $\frac{1}{2}$ or No. 1; or, if he has made a small stream of urine, a gum catheter of corresponding size may be selected. The stylet should be removed, the end turned up a little, and a very gentle attempt be made to insinuate the catheter, warmed and oiled, through the stricture. Should the instrument pass fairly into the bladder, the surgeon will learn by the issue of a few drops of water that all is right, and he must tie the instrument securely in. The patient may immediately be able to relieve himself, not only through but by the side of the catheter; for often, in using instruments for the relief of retention from stricture, the mere pressure of the catheter against the face of the stricture will cause urine to flow, and great relief will be afforded. If, however, the stricture is a tight one, urine will not flow outside the instrument; the water may therefore be

allowed to drain drop by drop from the catheter until relief is afforded. If this relief is delayed, and the surgeon is satisfied that the catheter is in the bladder, he need not be in a hurry to remove the instrument. The patient may be soothed by a hot bath or by an opiate draught, and in time the stricture will dilate from the presence of the inlying instrument, and urine will be freely discharged by the side of the catheter.

Should the English gum catheter fail to pass either with or without its stylet, a small French olivary catheter may be attempted. If this is not successful, then a No. 1 silver catheter must be used, the patient standing or lying down from time to time, as the surgeon thinks best. The surgeon's left forefinger in the bowel is often of assistance, and not infrequently the introduction of a catheter will be much facilitated by placing the patient under the influence of an anæsthetic. If a catheter is successfully passed, whether a soft or a silver one, it should be tied in. (For the further treatment of the case, *see* STRICTURE OF THE URETHRA.) Should the stricture be a very severe one, it will be a great boon to the sufferer if the surgeon can arrange for catheterism to take place in the patient's bedroom, so that, when once the catheter is passed, it can be tied in, and the treatment of the stricture commenced. Otherwise, if the catheter has to be withdrawn, the second catheterism, which is very likely to be soon necessary, may prove more difficult than the first from the swelling and possible laceration of the parts. Supposing catheterism fails, and opiates and hot baths give no permanent relief, the surgeon has the choice of several modes of giving exit to the retained urine. This question will be further discussed at the end of the consideration of prostatic retention.

(5) *Prostatic Retention*.—If the sufferer is over fifty years of age, and without any history of stricture, the cause is probably prostatic. He should stand with his back to the wall; the surgeon should sit down in front of him, and pass a well-oiled No. 7 or 8 (Eng.) vulcanised india-rubber catheter. No skill is required; if it passes, all is well; if it will not pass, it must be removed, and a No. 7 or 8 French coudée catheter tried. The operator should make some mark on this instrument, so that on looking at the proximal end he can always tell, when the bent end is in the urethra, which way the bend is turned. Holding the penis up against the patient's abdomen, and passing the first five inches of the coudée catheter

vertically down the urethra, the surgeon keeps the penis and the catheter strictly in the middle line, and the bend of the instrument always towards the patient. As about the sixth inch is pushed in, he gradually brings the penis and catheter down to the level line, and as the next and succeeding inches of the catheter pass, slowly drops the penis and catheter until they almost point to the patient's toes. As a rule this catheter will ride easily into the bladder. If it does not enter, it is very probable that the point has caught in the prostatic sinus. To disengage the point of the catheter, it is gently withdrawn for about an inch or more, and turned on its long axis so that the bent-up end points laterally to the right or left, instead of upwards as it did before. An attempt is now made to pass it into the bladder; and repeated if unsuccessful, turning the point first to one and then to the other side. Frequently this manœuvre will prove successful.

If the *coudée* catheter will not go, a very soft-ended olivary catheter may be tried, and, if necessary, a large *coudée* (No. 12); for large instruments, although they give more pain than small ones, will often avoid, by reason of their size, an awkward place which will engage a smaller instrument. When all these instruments fail, a *bicoudée* will sometimes be successful. Here may be mentioned with praise the silk-web *coudée* catheters made in London, and of recent introduction. They are soft and highly polished, and in the writer's hands have passed when the ordinary *coudée* has failed. This is due to their softness, which makes them practically *bicoudée* catheters, and enables them to ride easily over the bar at the neck of the bladder.

If none of these catheters can be passed, the surgeon may take an English gum catheter, No. 8 or 9, and, removing the stylet, may put the catheter into any shape he likes by softening it in hot water, moulding it to his taste, and then making the shape for a time permanent by dipping the catheter into cold water. A very excellent plan is to keep one of these catheters permanently on a stylet which has been over-curved. When required for use the stylet is removed, and the catheter keeps its curve so well in the urethra, that the end will often successfully surmount the obstacle at the neck of the bladder. Another plan of using the English gum catheter, in these difficult prostatic cases, is to introduce it on a stylet. When the catheter becomes engaged at the obstruction, the instrument is held in place with the one hand, while the

other hand withdraws the stylet for an inch or two. This movement causes the end of the catheter to rise and come forward in the prostatic urethra, frequently with the happy result of entrance into the bladder.

If the operator is still unsuccessful, silver catheters must be tried, of various curves (prostatic), with the patient either standing or lying. The introduction of the left fore-finger into the bowel will often facilitate the passage of these instruments by pressing the point forwards. In the use of all prostatic instruments, when once a catheter is passed, the patient must be closely watched as the water is drawn off, and the catheter at once plugged or withdrawn, should any signs of syncope arise. Speaking generally, it is unwise to draw off more than twenty ounces at the first catheterism. In all cases the patient should at once be put to bed, and for four or five days be kept warm and comfortable in the horizontal position. He must be carefully watched for a recurrence of retention, which will be sufficiently obvious. The great danger, however, consists in the patient after a few hours making some water naturally, without by any means emptying his bladder. This deceives the unwary surgeon, and the bladder is allowed to continue partially emptying itself until obstinate and even dangerous cystitis is set up. Within at least twelve hours from the first retention, with very rare exceptions, the catheter should be passed again immediately after the patient has made water, and the amount of water not passed naturally carefully noted. This amount will determine the future treatment. *See PROSTATIC HYPERTROPHY.*

In cases of difficult prostatic catheterism, the question will often arise after the bladder has been emptied—Shall the catheter be tied in or taken out? If the difficulty has been very great, and if the catheter introduced is a soft one, it may certainly be tied in, its orifice securely plugged, and the urine drawn off when necessary. Usually, such a catheter will require changing in four or five days, and it will be well to keep the interior of the bladder free from decomposing urine, by daily injections through the catheter of a warm solution of boracic acid (3 to 4 drachms of the saturated solution to four ounces of water), or of carbolic acid (℥ij. to ℥iv.). Such a proceeding is justifiable if great difficulty has been experienced, and if the urethra has been much injured; and it is occasionally justifiable in ordinary cases, if the surgeon cannot frequently visit his patient. Here, however, it may be said that, when a man has had prostatic retention

of urine his life hangs in the balance, and whether the balance goes up or down largely depends on the care his surgeon can give him, the most essential part of this care being immediate and easy catheterism directly the bladder cries out for relief. Unless under absolute necessity, a silver catheter must not be tied in. A soft catheter may usually be safely retained—and stress may be laid upon this, as formerly it was taught that a catheter should never be tied in in cases of enlarged prostate. If the retention has with great difficulty been relieved by a silver catheter, and if it is desirable to tie a catheter in, the retention of the metal instrument may be avoided by placing a soft catheter on a stylet, bending it to exactly the same shape as the silver catheter, and passing it directly the silver one is withdrawn.

With patience, gentleness, and skill, the surgeon should always succeed in passing a catheter in a case of prostatic retention. But supposing that from great irregularity of the passage, want of suitable instruments, or in consequence of injury inflicted during previous attempts at catheterism, no instrument can be introduced, what is the surgeon to do? In the first place, for obvious reasons the relief must be immediate; any delay is absolutely wrong; and in the second place the relief must be obtained by the simplest means. The simplest means of evacuating a distended bladder is, undoubtedly, by suprapubic aspiration. Afterwards, with rest and after a thorough evacuation of the bowels, a catheter may often easily be passed into the bladder through the urethra. Should retention, however, recur, and catheterism again fail, a second or even a third aspiration is permissible. But, although the bladder has been safely aspirated many times (ten or twelve), fatal extravasation and abscess have been known to follow a second aspiration, and the surgeon is advised not to aspirate the bladder more than two or three times. Afterwards, if a catheter cannot be passed, suprapubic puncture with trocar and canula is recommended.

There are other methods of puncturing the bladder, notably the rectal one, which still has advocates. These methods are all described under **BLADDER**, Puncture of the. *See also* BOUTONNIÈRE, the Operation of.

G. BUCKSTON BROWNE.

RETINA, Affections of the.—**CONGENITAL ABNORMALITY**.—Occasionally, the nerve-fibres regain, at the edge of the papilla, their medullary sheath which had been previously lost at the lamina cribrosa,

and we have the condition known as 'opaque nerve-fibres.' The papilla itself often escapes, but sometimes its periphery, and, very rarely, even its entire surface, with the exception of the physiological cup, may be involved and appear white in consequence. The condition usually occurs in the form of a brilliantly white patch, narrower at the end next the papilla, with which it is nearly always continuous. Its broader peripheral end has a ceased-out, brush-like appearance, from the separation of the fibres. The affected area is generally at the upper or lower edge of the disc, and the large blood-vessels there present are more or less concealed by it. Exceptionally, it extends all round the disc, and, still more rarely, the patch may be detached from the disc altogether. We get a scotoma corresponding to the extent of the opaque area.

DISEASES.—With the exception of its blood-vessels and its pigment-epithelium, the retina is almost perfectly transparent, and therefore practically invisible ophthalmoscopically. Its diseased conditions then may be recognised by a loss of its transparency, or by changes in its circulation or in its pigment layer.

CHANGES IN THE SIZE, COURSE, AND STRUCTURE OF THE BLOOD-VESSELS.—First, we will consider shortly disturbances of the retinal circulation, as evidenced by changes in the size and course of the vessels and in the structure of their walls.

In judging of the *size* of the retinal vessels we regard chiefly the larger branches on the optic disc, comparing them with the mental impression of those of an average normal eye. Slight departures from the normal may readily be overlooked by such a method, and the observer must be careful to note the number of the branches of artery or vein on the disc, as, the smaller the number of these, the larger each one will be in proportion in the healthy fundus. Again, by the direct method of observation, the vessels will appear larger in the myopic and smaller in the hypermetropic eye, while by the indirect method the opposite effect will be produced (**OPHTHALMOSCOPY**). It is important to observe any change in the relative size of arteries and veins, the diameter of the normal artery being from two-thirds to three-fourths that of the corresponding vein.

A congenital general enlargement of the retinal vessels, containing unusually dark blood, is met with in congenital defects of the heart with cyanosis. A temporary distension of the retinal vessels exists in active hyperæmia, as from vaso-

motor influence in exophthalmic goitre, local overfilling from obstruction in another arterial region, &c. A general reduction in the size of the vessels is sometimes found in general anæmia and in Bright's disease, or it may be due to local pressure on the central artery. The arteries alone may be small in cases of neuritis and of embolism, and occasionally in general anæmia, where the veins appear large from being flattened, owing to their reduced intravascular tension. In true venous distension we find these vessels large, rounded, abnormally dark, and tortuous. This condition of venous distension may be dependent on local or general causes. Locally, it may be due to neuritis, or thrombosis of the central vein, and is found sometimes in glaucoma and in cases of rapidly occurring pressure on the cavernous sinus. The retinal veins may be congested, as part of a general venous congestion in the head from pressure on the jugular or innominate veins. Again, the retinal congestion may be part of a general congestion, the latter being either *acute*, as from coughing or any effort, or *chronic*, as in mitral disease and emphysema of the lungs. An irregular dilatation or varicosity of the veins is sometimes observed in aged persons and in glaucoma.

A *tortuous course* is characteristic of congested veins, but it has exceptionally been found with normally sized vessels in healthy eyes. An antero-posterior curve in the vessels may be caused either by swelling or detachment of the retina, and is recognised mainly by loss of the central light-streak.

Visible pulsation in one or more of the large veins on the disc is not uncommon in the normal condition, and is best seen just at the edge of the physiological cup. It also occurs, pathologically, from the same causes that produce arterial pulsation. This latter is never normally present, but occurs in acute anæmia, in aortic regurgitation, and in increased intra-ocular tension, whether from disease or mechanically produced by finger-pressure from without. It is usually visible only in the vessels on the disc itself, but in aortic cases it may be traced peripherally to branches of comparatively small size.

Changes in the vascular walls are sometimes recognisable by the ophthalmoscope, a distinct white line bounding each side of the red blood-column. This appearance may be due to thickening of the middle or outer coat of the arteries, or to an accumulation of leucocytes in the peri-vas-

cular sheath. Aneurisms may occur either on the primary branches of the central artery, or on the smaller twigs and capillaries of the retina. They are of clinical importance from their being usually associated with a similar condition of the small vessels in the brain and elsewhere.

Apart from circulatory changes, we may diagnose retinal affections by an interference with its normal transparency. Thus, we may have diffuse haze from œdema, red patches from hæmorrhages, black opacities from deposits of pigment, or opaque white areas from exudation or fatty changes. Again, it and its vessels may be elevated in part of the fundus as the result of an exudation or solid growth beneath.

HÆMORRHAGES may occur in the retina at any part of the fundus, and are readily recognised, when recent, from their bright red colour. There may be only one or two, or they may be practically countless; and they may be of any size, from a barely visible spot or streak to a patch much larger than the optic disc. Occasionally, a single, large, round or oval, sharply defined hæmorrhage occurs at the yellow spot. Hæmorrhages are most commonly found in the neighbourhood of large vessels in the nerve-fibre layer, and then present a striated or 'flame-shaped' appearance, from the extravasated blood lying between the nerve-fibres. Not infrequently they occur in the inner nuclear layer from the fine capillary networks found in this position, and they are then round or irregular in form. If large, they may either burst into the vitreous or cause detachment of the retina. They interfere with sight according to their size and position; those at the yellow spot causing necessarily a large central scotoma. They become darker in colour with time, and absorption takes place gradually, its rapidity being greatest in hæmorrhages of small size and in those not associated with disease of the vessels. Ultimately no trace may be left, or there may be dark pigmentation or again yellowish-white spots.

Causes.—We may meet with them as part of an inflammation of the retina or optic nerve, but more frequently they are dependent directly on general conditions, or on retinal disease consequent on general conditions. The extravasation may be due to rupture of vessels or to diapedesis. The following statement will serve to show the manner of their occurrence.

A. Rupture of vessels from—

1. Increased intravascular pressure, local or general. (a) *Local*—e.g. from contusion of eyeball, venous thrombosis, optic

neuritis with much constriction of veins, and all forms of retinitis. (b) *General*—as from hypertrophy of the left ventricle, cough or other violent effort, stoppage of habitual discharges, the high arterial tension associated with gout, &c.

2. Rupture from sudden diminution of the vitreous support, as in wound of the globe and in iridectomy for glaucoma.

3. From weakness of a degenerated vascular wall, as in sclerosis, fatty degeneration, or miliary aneurisms of the retinal vessels; sometimes associated with embolism or thrombosis of the small arteries. The vascular change may be a simple senile condition, or may be a concomitant of a general affection such as Bright's disease.

B. Diapedesis may be the result of—

1. Increased intravascular pressure, or

2. An altered condition of the blood.

This latter is probably responsible for the hæmorrhages found in cases of diabetes, severe anæmia, leucocythæmia, ague, purpura, scurvy, and pyæmia. Retinal hæmorrhages are occasionally met with in young people without any obvious cause. Such cases are probably due to increased intravascular tension and altered conditions of the blood. They are commonly found in association with the hæmorrhagic diathesis.

The *treatment* of hæmorrhage of the retina must necessarily vary with the general and local states with which it is associated or on which it depends. In recent cases iced compresses may be applied to the lids.

INFLAMMATION OF THE RETINA is usually the result of some general disease, and the classification of its forms commonly adopted is clinical rather than pathological. When the inflammation commences in the retina the papilla is generally secondarily involved, and, again, retinitis—mainly of the inner layers, is not infrequent in cases of papillitis. The principal ophthalmoscopic evidences of retinitis are loss of retinal transparency, dilatation of the veins, and a tendency to the occurrence of hæmorrhages and white patches. Anatomically, we find serous infiltration of the retina, swelling of the Müllerian fibres, fatty degenerations, inflammatory exudations, hæmorrhages in the inner or middle layers, and hypertrophy and sclerosis of nerve-fibres. Sometimes there are numerous opacities in the vitreous. The impairment of vision, both temporary and permanent, varies much in different cases.

The *treatment* must be regulated mainly by the general condition of the patient. All strong light should be cut off from the eyes

by wearing dark neutral-tint glasses, and complete rest be ordered. Counter-irritants or leeches to the temples may be advisable.

HÆMORRHAGIC RETINITIS is the term applied to cases where we have numerous hæmorrhages along with evidence of retinal inflammation, occurring in association with disease or disorders of the circulatory system. It usually affects one eye only. The hæmorrhages are small and numerous, and are found widely distributed over the fundus, chiefly in the inner layers of the retina. The papilla is hyperæmic, with blurred margins; there is a slight diffuse opacity of the retina, and its veins are dark and swollen. Occasionally, we find a few circumscribed white spots in the inner retinal layers, probably due to fatty degeneration or to aggregation of leucocytes.

Causes.—This disease is found in connection with diseased cardiac valves, hypertrophy of the left ventricle, aneurism of the great vessels, and with arterial sclerosis. It also sometimes occurs on sudden suppression of the catamenia at the climacteric period. The manner of its production is obscure. It may perhaps be explained by chemical changes in the blood, or by multiple embolism of the small twigs of the central retinal artery. There are usually permanent changes left in the retina and papilla.

The *treatment* must be general; iodide of potassium may be used with apparent advantage.

ALBUMINURIC RETINITIS is characterised by the presence of numerous light-coloured patches, and of minute, opaque, very white dots or striæ at the yellow spot. The affection of the papilla varies between slight passive congestion and great engorgement; in the latter case there is a marked tendency to hæmorrhages, which occur principally in the nerve-fibre layer. The soft-edged light-coloured patches occur early, and are found mainly in an annular zone surrounding the papilla. The white punctate spots appear later, and are arranged in the form of a star or asterisk, with its centre at the fovea centralis. Both eyes are practically always affected. The large light patches are usually behind the retinal vessels, and are due to a deposit of fatty granules in the nuclear and internuclear layers. When superficial to the vessels, the opacity is caused by a local hypertrophy of the nerve-fibres. The white dots at the macula are due to a fatty degeneration of the inner ends of the Müllerian fibres.

Causes.—This retinitis is most commonly associated with chronic disease of the kidney, especially the contracting form, but it

is also frequently found in the albuminuria of pregnancy and not uncommonly in acute nephritis after scarlatina. It has been observed in about 13 per cent. of all cases of albuminuria. The occurrence of the ocular changes is probably to be explained by the altered condition of the blood, arising from retention of products that ought to be eliminated and from the hydræmia produced by the loss of albumen. We may have a papillitis or a papillo-retinitis, in connection with albuminuria, without the typical appearance above described. On the other hand, retinitis quite of the albuminuric type occurs exceptionally in connection with intracranial affections, cardiac disease, diabetes or anæmia, without there being any evidence of renal disease.

If improvement takes place in the renal affection the retinal changes may subside, but the star-shaped grouping at the macula lasts for a long time. We often ultimately get optic atrophy, narrowed vessels with double white lines, and disturbances in the retinal pigment. Sometimes, we get a restoration of perfect vision with a normal fundus, as in the cases associated with pregnancy.

SYPHILITIC RETINITIS.—This is an inflammation of a chronic diffuse type without gross ophthalmoscopic changes. The larger veins are somewhat distended and dark, and the outline of the papilla is blurred. The retina itself becomes hazy, especially in the neighbourhood of the papilla and along the larger vessels. White patches and hæmorrhages are rare. Very commonly there are numerous dust-like opacities in the vitreous. It generally occurs secondarily to choroiditis, but may exist alone, and either in one or both eyes. It usually comes on late in the secondary stage, about the end of the first year or later, and is most common in subjects of mature or advanced age. It has been also met with in the congenital form of the disease.

Symptoms and Course.—There is considerable failure of vision, sometimes micropsia, and always marked night-blindness. It lasts for months, but the result is generally favourable, the retina recovering its transparency and the other changes disappearing.

The *treatment* must be energetically anti-syphilitic, mercury being the remedy chiefly to be relied on.

RETINAL DISEASE IN LEUCOCYTHÆMIA occurs in about one-third of the cases of the splenic form. It is always bilateral, but often unequal in degree in the two eyes. In a typical case, we find prominent white

patches surrounded by a hæmorrhagic border: these are met with at the limits of the retinal circulation—viz. in the centre, and quite at the periphery of the fundus. The general fundus-reflex is of a bright orange-yellow colour; the retinal arteries are bright orange and the veins light carmine. The usual signs of retinitis are also present, such as blurring of the edges of the disc, slight opacity of the retina, and occasionally small hæmorrhages and white spots.

RETINAL DISEASE IN DIABETES occurs comparatively rarely, but is always bilateral. Usually we simply find retinal hæmorrhages in this association, but, in severe, long-continued cases, retinitis may occur with appearances much like what we find in albuminuria. In the diabetic form, however, the whitish patches are generally smaller, and there are very frequently opacities in the vitreous. Vision is necessarily much reduced in all severe cases, and the prognosis is unfavourable.

CENTRAL RETINITIS FROM EXPOSURE TO DIRECT SUNLIGHT has been met with in several cases after observation of an eclipse. Immediately after the exposure there is more or less loss of central vision, in the form of a positive scotoma. In severe cases this persists, though generally some improvement takes place. Ophthalmoscopically, the macula is found to be more darkly pigmented than usual, and the position of the fovea is occupied by a greyish-yellow spot. It is probable that the pathological changes consist in proliferation of the pigment-epithelium, and exudation between it and the chorio-capillaris. In severe cases with persistent scotoma, there is possibly also destruction of the outer segments of the rod and cone layer.

The *treatment* consists mainly in the use of dark glasses, and leeches or counter-irritants to the temple. Later, strychnine and galvanism have been recommended.

RETINITIS PIGMENTOSA is a term in common use to designate a disease where a certain group of symptoms and definite course are usually found in association with pigmentary changes in the retina. The disease is symmetrical and chronic, usually beginning in early life, and often terminating in blindness soon after middle age. Night-blindness is the earliest and most characteristic symptom. There is next loss of visual field, generally at first in the form of an annular scotoma, but the periphery soon also fails, and a small central field alone remains. Central vision may remain good for a long time. The

affection is often found in several members of the same family, and such patients are not infrequently defective in intellect. It is believed by some that consanguinity of parents may produce it.

Ophthalmoscopic examination shows a yellowish-red waxy atrophy of the optic disc; marked diminution in size of the retinal vessels, especially the arteries; and much pigment in the retina, largely in its inner layers, where black masses, shaped somewhat like bone-corpuscles, lie superficial to the retinal blood-vessels. This pigmentary deposit is found chiefly in a belt situated midway between the centre and the periphery of the fundus, and thinning out at each edge. There is no hyperæmia at any period of the disease. No constant relation exists between the amount of pigment or other ophthalmoscopic change and the loss of sight; indeed, we may have the usual symptoms and course of the disease without the presence of any abnormal pigment in the retina. Similar changes in the retina and optic nerve are found, not infrequently, secondary to choroidal inflammation, but in such cases we have the atrophic changes in the choroid in addition. Ophthalmoscopically considered, pigmentary degeneration of the retina is essentially the same from whatever cause it may arise. But the term *retinitis pigmentosa* has been chiefly used as a clinical designation, and as denoting the group of symptoms, course, and ophthalmoscopic appearances of, practically, the only form of pigmentary degeneration which can occur without retinitis; while the symptoms and course of this disease may be present without the usually associated pigmentary degeneration. The condition is in reality a chronic sclerosis, occurring either as a primary disease or secondary to intra-ocular inflammation, and generally, but not always, associated with a pigmentary degeneration of the retina. Pathological examination of the retina shows an increase of the connective-tissue framework, atrophy of the nervous elements, and thickening of the walls of the vessels.

The pigmentary changes are partly atrophic in nature, but mainly consist in an infiltration of the retina with newly formed pigment aggregations. These latter follow the course of the vessels, and are found most conspicuously at their branchings.

Galvanism is the only form of *treatment* of any avail in this affection, sometimes causing a marked improvement both in field and in central acuity. It ought to be employed as described previously (*see* OPTIC NERVE, Atrophy of), and if it prove ser-

viceable, should be persevered with, as otherwise the improvement cannot be expected to last long.

THROMBOSIS may occur in the central artery, but it is rare, and indistinguishable during life from embolism. Occasionally, thrombosis affects the central vein behind the eyeball or one of its large branches on the fundus, and usually leads to deterioration of vision and marked ophthalmoscopic appearances. The sight fails suddenly, and more or less completely according to the extent of the closure and the size of the vessel affected, but generally it soon improves again somewhat. In a marked case, the veins of the retina are found to be tortuous and enormously distended, the arteries often small, and both sets of vessels near the disc are concealed in great measure by large opaque, white, diffuse masses of exudation and by numerous hæmorrhages. The latter are of all sizes here, and smaller ones extend well out to the periphery of the fundus. The yellow spot region is of a light clay-colour, with the fovea centralis conspicuous as a very minute cherry-red spot. The papilla looks normal, with the exception of slight blurring of its margins. The affection occurs principally in the aged, often with a family history of gout, and nearly always in only one eye.

EMBOLISM may occur in the central artery itself or in one of its branches, and may be either complete or partial. It is seldom bilateral, and is more common on the left than the right side. Embolism in other vessels always co-exists, the usual cause being heart-disease, especially mitral. It may be found in association with atheroma of the aorta, pregnancy, and Bright's disease, and may consequently occur at any age. In complete embolism the plug is generally near the lamina cribrosa, and the leading symptom is sudden blindness of one eye. There is frequently a temporary improvement a few hours after its occurrence, from the establishment of an imperfect collateral circulation, but the usual final result is absolute blindness. In plugging of a branch, the visual defect is usually partial from the first, the final result likewise being loss of vision corresponding to the distribution of the affected vessel.

Ophthalmoscopic Appearances.—The optic disc is pale, with somewhat blurred edges. There is a diffuse, misty opacity of the retina from œdema, best marked in the yellow spot neighbourhood. Corresponding to the fovea centralis is a bright red spot, where the normal choroidal reflex shines through the outer layers of the retina, and

appears specially red by contrast with the surrounding cloudiness. The large vessels are usually small near the disc, the arteries being often reduced to mere white threads or to narrow red blood-columns bounded by opaque white lines. Within the first day after the occurrence of an incomplete blocking of the vessel, the blood may be seen both in the arteries and veins in the form of short detached columns. This appearance is most common in the arteries, where the short columns may be observed to move forward in a jerky fashion. Increased tension from finger-pressure cannot produce visible pulsation in the vessels. Small hæmorrhages often occur near the optic disc. After some days the pulsation on pressure returns in all the blood-containing vessels, the retinal œdema slowly disappears and the disc gradually becomes atrophic. Where a branch only is affected, changes similar to the above are found in its area of distribution.

As regards *treatment*, massage of the eyeball has proved beneficial in several cases, and should be tried. It is probably best effected by alternate, prolonged, moderately firm pressure on the globe and sudden removal of this pressure.

DETACHMENT OF THE RETINA.—In this condition the retina proper is separated from its pigment epithelium, and a serous fluid usually occupies the interval. Except at the fovea centralis and ora serrata, the retina is naturally very loosely attached to its epithelium; and fluid once present between them readily gravitates downwards to the lower part of the fundus, where old standing detachments are most commonly found. Occasionally, the displacing agent is an extravasation of blood, or a solid plastic exudation from choroiditis, or a choroidal tumour pushing the retina forward. Sub-retinal fluid may be effused, primarily, either as a hæmorrhage or as a serous exudation in connection with inflammation or tumour of the choroid. The common reason of detachment, however, is probably some alteration in the vitreous—either a mere diminution of its support to the retina, or contraction of connective-tissue formations within it forcibly dragging the retina away from its normal position. In such cases the sub-retinal effusion of fluid is secondary.

One of the most common *causes* of retinal detachment is progressive myopia, where we have both choroidal inflammation and alterations in the vitreous. Perforating wounds of the sclerotic may lead to detachment, either immediately, from a loss of vitreous, or subsequently, from contraction

of the cicatricial tissue at the seat of puncture. In many cases no cause can be discovered.

Anatomically, the detached retina undergoes a gradual degeneration, the nervous elements being destroyed and its connective tissue hypertrophied.

Ophthalmoscopic Appearances.—On illuminating the patient's eye with the ophthalmoscopic mirror held at twelve to eighteen inches distance, we observe a want of uniformity in the reflex obtained, a greater or lesser extent of the fundus appearing bluish-grey or whitish in contrast to the normal red seen elsewhere. This discoloured portion is usually folded and more or less tremulous, and corresponds to the detachment; on its surface we see the retinal vessels as slender, dark, stiff-looking tortuous lines. In a recent shallow detachment we find no such difference in colour, but its vessels have the characters just mentioned, though they stand out less conspicuously, from the absence of the strong contrast furnished by a light-coloured surface. By careful measurement of the refraction of the vessels, on the affected and unaffected areas of the retina, we can estimate the depth of the detachment, and in difficult cases determine whether really a displacement exists. Having satisfied ourselves of the presence of a detachment, we should note its extent and the character of its boundaries, its mobility on movements of the eye, its colour, its depth, and the degree of folding. We are thus in a position to decide as to the probable nature of the displacing agent. Not infrequently, floating opacities in the vitreous, changes in the lens, or iritic adhesions are present and interfere with our examination; under such circumstances the indirect method of observation is particularly valuable. The grey colour of a detachment is due to the opacity of the retina; the darkness of the blood-vessels is due partly to loss of the central light-streak, partly to contrast, but mainly to the fact that they are principally seen here by *transmitted* light, the greater part of which is absorbed by the blood-column.

Symptoms.—There is frequently a history of sudden impairment of vision, objects appearing distorted or as if covered by a thick black veil. Sometimes we have complaints of flashes of light and of red or blue colour-sensations. Light is diminished in the part of the field corresponding to the detachment. Central vision may remain good for some time if the macula has escaped; but, in the majority of cases, the detachment extends gradually, and the sight

becomes progressively worse until, ultimately, there is complete blindness or only the barest perception of light.

Treatment.—In recent cases we can often get satisfactory improvement of vision for a time at least, though the measures most successful are decidedly irksome. Rest in a dimly-lighted room is particularly to be recommended, the patient lying on his back on a bed or couch, and the affected eye kept covered with a pressure-bandage. All exertion or sudden effort must be avoided, and the bowels are to be carefully regulated. Puncture of the sclerotic at the site of the displaced retina, so as to permit of the escape of the sub-retinal fluid, is, possibly, a judicious preliminary to the above method of treatment. Repeated subcutaneous injections of pilocarpine have also been used and approved of by many, but their employment is not without risk, and the advantage problematical. Neither puncture nor pilocarpine ever does much good without rest, and it is extremely doubtful whether the latter alone does not give results as satisfactory as any.

GLIOMA OF THE RETINA is essentially a disease of early life. It commences insidiously without inflammation, grows rapidly, and, if left to itself, soon leads to the death of the child. By its growth forwards it soon fills the eyeball, perforates the sclerotic or corneal margin, and involves the other orbital structures, so that, finally, we get the appearance of an enormous red fleshy protrusion without any visible trace of the globe itself. In its extension backwards it travels along the optic nerve, and ultimately involves the brain—not infrequently it causes secondary deposits in the scalp, brain, the neighbouring lymphatic glands, and occasionally in the liver and other distant parts. Rarely it attacks both eyes independently. It has occasionally been met with in several members of the same family.

Diagnosis.—In as far as its onset is painless and unaccompanied by inflammation, the attention of the parents is generally first aroused by seeing a whitish reflex from behind the pupil. The vision is commonly very early affected, while the eye still looks natural and the tension remains normal. By the time the whitish reflex is observed, however, there are often signs of secondary glaucoma, increased intra-ocular tension, dilatation of the pupil, and engorgement of the scleral veins, while the eye is now sometimes tender. By focal illumination we see a yellowish-white, rounded or lobulated, solid-looking mass in the vitreous,

with blood-vessels and often small hæmorrhages on its surface. The vessels are easily distinguished from those found on a detached retina by their irregular distribution, different mode of branching, greater breadth, and somewhat brighter red colour.

Pathology.—Its naked-eye appearance is that of a soft, marrow-like growth, of a whitish or reddish-white colour, sometimes studded with small, white, chalky-looking dots. The formation originates in the neuroglia of the retina, usually in that of the inner granular layer. We find here deposits of small roundish cells, closely packed together in a structureless, finely granular interstitial substance. Later on, as the tumour grows, we find large groups of spindle-shaped cells and fibrillated bands (gliosarcoma), and occasionally evidences of fatty and calcareous degenerations.

The *treatment* consists in early removal of the affected eyeball, along with as much nerve as we can conveniently get at. If the other orbital contents are affected while the nerve at the point of section appears healthy, it is advisable to thoroughly clean out the orbit and then destroy the surface with chloride of zinc paste. If the tumour has attained a large size, its removal cannot be expected to save life, and it is often advisable in these circumstances to leave it alone. In such a case, the child's health must be kept up as well as possible, and opiates given, if necessary, to relieve pain and induce sleep. R. MARCUS GUNN.

RETINOSCOPY (Keratometry).—(In this article the following abbreviations are used :—M. = myopia or myopic, H. = hypermetropia, As. = astigmatism, E. = emmetropia, D. = dioptré, v = vision.)—Retinoscopy is a method of determining by the ophthalmoscope the nature and extent of anomalies of refraction of the eye. It depends on the following optical facts. Supposing a patient, with artificially dilated pupil, seated in the ordinary position for ophthalmoscopic examination, and that we place ourselves at about forty-eight inches from him and reflect the light from a well-defined gas-flame into his eye, by means of a *concave* perforated mirror of about nine inches focal length. If we then look through the perforation in the mirror, we see the ordinary fundus-reflex. Now, if we give the mirror slight rotations about its vertical axis, so that it faces in different directions, still remaining in front of our eye, we then see something that has the appearance of a shadow with a vertical edge, moving horizontally across the illuminated area of the

patient's pupil, either in the same direction as the mirror changes face or in exactly the opposite direction. If, for instance, we turn the mirror to our right, the shadow moves horizontally, either to the right or to the left. Now, if it moves to the right—i.e. in the direction in which the mirror changes face—the patient's eye is M.; if it moves to the left—i.e. in the opposite direction to that in which the mirror changes face—the eye is (generally) H.; if no distinct shadow-movement is seen at all, the eye is E. (nearly).

The observation just described is the germ of retinoscopy. It is convenient to use the terms 'with' and 'against' in describing the movement of the shadow with reference to that of the mirror; for the future, then, we shall speak of the shadow moving 'with' or 'against' the mirror, according as it moves in the same or opposite direction to the change of face of the mirror.

It may be shown that this so-called shadow is really the edge of the image of the gas-flame, formed by one reflection at the mirror and two refractions through the patient's eye, and further, that the change from movement 'with' to movement 'against' takes place, not where the patient's eye is exactly E., but where it is M. about 1.0 D; but as this does not differ much from E. we may say roughly that in M. the shadow moves 'with' the mirror, in H. 'against' the mirror, and that in E. no distinct shadow is seen at all. We have supposed that the mirror is rotated round its vertical axis; this, however, is not at all essential; any axis will do, but perhaps the vertical or horizontal is most convenient. Further on, when we come to treat of As., we shall have to suppose rotations round various axes, and it will be conducive to clearness to abandon altogether this term—rotation round an axis—and speak of the mirror being turned in the direction of a certain meridian of the patient's cornea, this meridian being the one perpendicular to the axis round which the mirror is rotated. Thus, when we speak of the mirror being turned in the horizontal direction, we mean that it is being rotated round its vertical axis; when we speak of its being turned in a direction up and *in* at an angle of 30° with the vertical, we mean that it is being rotated round an axis inclined up and *out* at an angle of 30° with the vertical. Adopting, then, this phraseology now, we say that in cases of M. or H. the shadow moves in the same direction ('with' or 'against') in which the mirror is turned. Further, the edge of the shadow is perpen-

dicular to the direction in which the mirror is turned. It must also be stated here that the above phenomena as regards 'with' and 'against' apply to a *concave* mirror only; with a plane or convex mirror, the directions in which the shadow moves are reversed. We can then by this method at a glance diagnose the *quality* of the refraction; but, further, we can estimate its *quantity*. To do this it is only necessary to fit the patient with a trial-frame, and put in it lenses to correct the refraction—i.e. concave or negative lenses in the case of M., convex or positive in the case of H.; in either case we find what lens causes the shadow-movement to disappear.

We know that now the eye *plus* the lens forms an emmetropic (nearly) combination, and the strength of the lens gives the amount of M. or H. The correct lens is in many cases found only after several trials, but a little practice will often enable the observer to make an approximation to it at once. With this view, he should note especially the *intensity* of the fundus reflex; if this be bright, the case is one of low ametropia (whether M. or H.); if it be dull, it is a case of high ametropia. To take an example:—

The patient's eye shows a dull fundus-reflex, and the shadow moves 'with.' The case then is one of high M. We put up a lens of, say, -7 D in the trial frame. The reflex is now much brighter, and the shadow still moves 'with.' 7 D is then not strong enough to connect the M.; we put up -9 D, and now we get no shadow at all; the amount of M. is then 9 D (nearly). On trial with test-types at twenty feet, we find the M. is actually 10 D, rather more than we found by retinoscopy; this results from the fact mentioned above, that the condition in which no shadow at all is seen is not one of exact E. but of M. of about 1 D. In all cases, it will be found that the actual M. is about 1 D *greater* than that indicated by retinoscopy, and (for the same reason) the actual H. about 1 D *less*.

To proceed now to the phenomena of retinoscopy in *Astigmatism*. In M. and H. we have seen that the direction in which the mirror is turned is immaterial, a shadow-movement being procurable in any meridian by turning the mirror in the direction of that meridian. In astigmatism, however, we get a shadow-movement in the direction of the two principal meridians *only*, and this no matter in what direction the mirror is turned. It follows that if the mirror be not turned parallel to one of the principal meridians, the consequent shadow-

movement is not parallel to the direction of turning of the mirror. This fact at once indicates that astigmatism is present, and reveals the directions of the principal meridians. These being ascertained, we proceed to examine their refraction, turning the mirror for that purpose in the direction of each of them successively. With a little practice this can be done pretty accurately, the direction in which the mirror is being turned being shown by the direction in which the circular patch of light (reflected from the mirror) travels across the patient's face. Take one of these chief meridians: Turning the mirror in its direction, we have, as a criterion of its refraction, a shadow moving parallel to it, and with edge perpendicular to it. All that has been proved of the shadow in any meridian in the non-astigmatic eye is true of this one meridian in the astigmatic: the movement of the shadow shows whether the meridian is M. or H., and the strength of glass necessary to cause the shadow to disappear gives the amount (nearly) of the M. or H. We note the lens required, and then proceed to examine in the same way the other chief meridian. Having thus determined the refraction of the two chief meridians, we put in the trial-frame the indicated spherocylindrical combination, and try the patient with the test-types at twenty feet. To get the best vision, we expect to have to slightly strengthen the spherical lens in M., and weaken it in H., and other slight changes in the strength of the cylinder and the direction of its axis may be necessary before the most satisfactory result is obtained. But, as a rule, the lens indicated by retinoscopy comes very near to the one finally chosen.

Take a case. Right eye. Dull fundus-reflex. Shadow moves 'against.' With + 8 D a well-defined shadow moving 'with' the mirror in meridian 45° up and out; no shadow seen in meridian perpendicular to this; that is, + 8 D corrects this latter meridian, + 6 D gives no shadow in meridian 45° up and out, and a faint shadow moving 'against' in meridian perpendicular to this—that is, + 6 D corrects the former meridian, $\frac{+6\text{ D}}{+1.50\text{ D cyl.}}$, axis 45° up and out gives no shadow in any meridian. The lens that gives the best vision is $\frac{+5.50\text{ D}}{+1.50\text{ D cyl.}}$, axis 50° up and out, and with this $\frac{6}{9}$ is read, v without the cylinder being only $\frac{6}{36}$.

Very often in cases of compound astigmatism the As. is not evident at first, and only appears when, in the course of correcting the apparently simple spherical anomaly, we put up a lens that nearly corrects one meridian; the shadow in the other meridian then stands out clearly. Mixed astigmatism is diagnosed at a glance, the shadows in the two chief meridians moving one 'with,' the other 'against.'

In conclusion, a few practical hints may be given. A mydriatic is often necessary, especially in cases of astigmatism. Where a mydriatic is not used, the patient should be directed to turn his eye so that the light from the mirror falls on the optic disc; in this way the greatest dilatation of the pupil is obtained. The surgeon should get into the habit of sitting always at about the same distance from the patient, and using the same intensity of light.

A dull fundus-reflex, suggesting high ametropia, may be caused by pathological changes in the media of the eye.

Irregular, broken shadows generally mean opacities of the cornea.

The retinoscopic examination must, generally, be considered only preliminary to the usual test with lenses and types at twenty feet.

A much fuller account of the method, especially in its theoretical aspect, is to be found in the *Royal London Ophthalmic Hospital Reports*, vol. x. part iii.

W. CHARNLEY.

RETRO-NASAL CATARRH is a chronic inflammatory condition of the mucous membrane lining the naso-pharynx and the posterior part of the nasal cavities. It is frequently associated with chronic nasal catarrh and granular pharyngitis. Several varieties have been described, such as the follicular, the hypertrophic, and the dry catarrhal, but they would appear to be merely stages of the same disease, and are here treated as such.

The *cause* of the catarrh is not altogether understood. The extension of chronic catarrh from the nose or pharynx, frequent exposure to alternating draughts of hot and cold air, the irritation of particles of dust, which are particularly apt to become lodged in this portion of the respiratory tract, and direct contagion have been regarded as exciting causes; whilst struma, syphilis, and residence in hot and damp climates are thought to predispose to it. It is much more common in America than in this country, and is there thought by Dr. Robinson to depend upon a 'catarrhal diathesis.'

Pathology.—In the earlier stages of the disease, there is simply a catarrhal inflammation of the mucous membrane; later, the mucous membrane and submucous tissue become infiltrated with inflammatory products, and the glands enlarged and stimulated to over-production, when the hypertrophic stage, or the follicular variety, of the disease is reached. Still later—it may be after a few months or many years—the mucous membrane, in consequence of the contraction of the inflammatory exudation, shrinks and atrophies, whilst its glands are destroyed to a greater or less extent. The parts now appear glazed and dry from deficiency of secretion; and in this atrophic stage the disease is spoken of as dry catarrh.

The *symptoms* vary according to the stage of the disease, but space does not permit of their being given in detail. In a well-marked case, say in the hypertrophic stage, the period at which the surgeon is perhaps most frequently first consulted, the chief complaints are of a feeling of stuffiness and obstruction at the back of the nose, a constant hawking up of a viscid, mucopurulent secretion, sometimes streaked with blood, and a peculiar alteration in the voice. At first there may be no fœtor, but later the breath, in consequence of the decomposition of the secretion, becomes peculiarly foul, and is then one of the patient's chief annoyances. Headaches, especially in the occipital region, deafness, and dyspepsia where the mucus is allowed to pass into the stomach, may also be present; and epistaxis may from time to time occur. Should chronic nasal catarrh co-exist, there will likewise be a discharge, and often an offensive one, from the nose.

On looking into the throat, the mucopurulent secretion will often be seen trickling down the posterior wall of the pharynx, which may present the characteristic appearances of granular pharyngitis. In the rhinoscope, the mucous membrane of the naso-pharynx, and especially that about the vault, appears thickened and often paler than natural, while the hypertrophied glands give it a peculiar mammillary and granular appearance, similar to that of granular pharyngitis. The mucous membrane lining the posterior pillars of the fauces, the back of the palate, and the orifice of the Eustachian tubes, usually presents similar changes, whilst that covering the sides of the septum is frequently œdematous, and that over the posterior ends of the inferior spongy bones greatly hypertrophied. The hypertrophied ends of these bones appear in some instances

as distinct tumours, having a globular shape and a purplish-red colour, and, together with the œdematous septum, may completely occlude the choanæ. The above condition of the mucous membrane is often obscured by the presence of the viscid mucus, and it may not be until this has been removed with the spray or syringe that the actual state of the parts can be made out. In the atrophic stages of the disease, the naso-pharynx appears more roomy than natural, and glazed and dry; whilst the muco-purulent secretion, in consequence of the atrophy of the glands, is not cast off, but becomes inspissated, forming greenish and adherent crusts, beneath which the retained secretion undergoes decomposition and gives rise to the horrible smell. The nasal chambers, if involved in the disease, present similar appearances when viewed from the front. Ulceration does not usually occur in the course of chronic retro-nasal catarrh. Should such be observed in the rhinoscopic mirror, the case will probably be one of a syphilitic nature, and dead bone will, in the majority of instances, be discovered if further search be made for it.

Treatment.—This should be both constitutional and local. When convenient, the patient should reside in a dry and equable climate, and all sources of irritation, —as dust or noxious vapours, alternations of heat and cold, and tobacco and spirits—should be avoided. Internally, cubebs, which appears to have a marked influence on the secretions of the pharynx, should be given in large doses, and chloride of ammonium, ammoniacum, arsenic, salicylic acid, and sulphur may be tried. Where there is evidence of syphilis or struma, appropriate remedies should of course be given. Locally, the parts should be frequently cleansed by weak carbolic or alkaline sprays, and subsequently astringed by sprays of sulphate or chloride of zinc, or tannin; or by the insufflation of powders of eucalyptus (1 part to starch 2 parts), iodoform, catechu, and the like. These remedies should be applied by the brush, the insufflator, or the post-nasal spray apparatus, the nozzle of which must be passed well behind the palate. Syringing, except when the crusts are very adherent, is to be deprecated, and the nasal douche should on no account be employed, as its use is not only attended by the risk of setting up disease in the middle ear, but it also induces a soddening of the mucous membrane, and does not reach the whole of the affected parts.

Where there is much hypertrophy of the posterior ends of the inferior spongy bones,

these should be scored with the post-nasal galvano-cautery, directed by the mirror, and the scoring repeated at intervals of a week to a fortnight, till the parts have been reduced to their normal size. Or, if preferred, the hypertrophied tissue may be removed at one sitting by Jarvis's snare, the wire of which is passed through the nostril, and guided over the end of the spongy bone by the finger behind the palate. Local anæsthesia should be induced by painting a 20 per cent. solution of cocaine over the mucous membrane before using the galvano-cautery; but chloroform had better be given if the snare is used. Should a hypertrophic condition of the mucous membrane of the anterior portions of the nasal cavities also exist, the galvano-cautery should be applied to the inferior spongy bones, the septum being protected by Shurley's ivory speculum; or the hypertrophic mucous membrane may be removed from over the inferior spongy bone by Robinson's forceps; or the whole bone cut away by the nasal pliers. The author can speak from personal experience of the value of the galvano-cautery in these cases, and much prefers it to the rougher treatment with the forceps or pliers. At the same time, he is bound to say that he has never seen any harm follow the evulsion of the inferior spongy bone, and this treatment is certainly more rapid than that with the galvano-cautery.

When the disease has reached the atrophic stage, a complete cure must hardly be expected; the distressing symptom of fetor can, however, be relieved by the use of deodorising and disinfecting sprays, and the sense of dryness by the internal administration of salicylic acid and cubebs. The insufflation of a powder of salicylic acid 1 part, gum acacia 2 parts, will often take away the fetor in a few hours. Should the anterior part of the nasal cavities be also affected by the atrophic form of catarrh, the like remedies should be applied by the anterior nasal spray-producer; whilst, at night, Gottstein's nasal tampons should be inserted, or an iodoform and eucalyptus bougie be allowed to dissolve in each nasal chamber.

W. J. WALSHAM.

RETRO-PHARYNGEAL ABSCESS.

An abscess in the connective tissue between the pharynx and the spine.

Cause.—It may be seen at all ages, but is most frequent in children, occurring even in infants; in them it is often idiopathic. It is said to be more frequent in boys than in girls (Cohen). When idiopathic, a history

of tubercle or syphilis is generally obtainable. Most commonly it is due to spinal caries, and is then chronic (*see* CARIES OF THE SPINE); but may complicate quinsy, and follow acute pharyngitis, especially after the exanthems, acute phlegmonous sore-throat, erysipelas, and syphilis; this last even occasioning caries at the same time. Injury to the pharynx from food, hot liquids, irritants, foreign bodies—e.g. impacted false teeth—may cause abscess.

Pathology.—Predisposition to inflammation of this part exists in its lymphatic structure, its constant mobility, and its liability to injury and variations in temperature. When idiopathic, suppuration begins in the submucous adenoid tissue (Bókai); when it begins in the deeper connective tissue, it is likely to be tubercular (Cohen). Caries of the front part of any of the cervical vertebræ determines the presence of pus behind the pharynx, though it often burrows down and becomes post-mediastinal. Retro-pharyngeal abscess is usually on one side of the middle line, and is accompanied by induration that can be felt below the angle of the jaw on the same side. It may point in the mouth, or on the side of the neck, and has been known to follow the brachial nerves to the axilla. The presence of the abscess causes mechanical dyspnoea and dysphagia, and by bursting may flood the larynx and suffocate. When post-oesophageal, it may open into the lung or oesophagus. Other complications are œdema of the glottis, and opening into the internal carotid artery. Sequestra are often discharged by the mouth, when caries is the cause of the abscess.

Symptoms and Diagnosis.—When *acute*, there is general pyrexia, with local heat and tenderness, dysphagia, huskiness, stiffness in the neck, and dyspnoea which is relieved by the erect posture. When sleeping, the patient snores as in tonsillitis. As the abscess enlarges, the head is thrown more backwards, and a tender swelling appears at the angle of the jaw. The mouth is opened with difficulty, and there may be profuse secretion of mucus (as in œsophagitis), which must not be mistaken for salivation. A fluctuating and very tender and unilateral swelling will be seen or felt in the pharynx, and when in the nasopharynx it pushes down the soft palate. The more laterally placed, the less the dyspnoea and the greater the resemblance to quinsy.

The *chronic* form, due to caries, often gives rise to no symptoms until there is dysphagia or dyspnoea; possibly the swell-

ing at the angle of the jaw may first attract attention; or the abscess may have become post-mediastinal, and even have opened into a bronchus or the pleura before it is discovered. Excepting the accompaniments of acute inflammation, the condition is as detailed above; and, as manipulation is less painful, fluctuation between the external swelling and that in the pharynx may at times be made out. Left to Nature, the abscess may increase so as to necessitate interference, or it may burst in the mouth, in the chest, or externally; or it may sometimes resolve. Parts of the cervical vertebræ may come away through it. When symptoms of cervical caries are obscure and unnoticed, the abscess may never be recognised; sudden death has been known to occur from atlanto-axoid disease where it was unsuspected, and the autopsy alone revealed a post-pharyngeal abscess.

Diagnosis.—The acute form of abscess in children may be mistaken for croup; but the dyspnœa is relieved by sitting up, is very intermittent, and unaccompanied by the crowing noise of croup. Dysphagia is a prominent symptom, the child even declining to try to swallow. Inspection of the throat reveals the condition at once. The chronic form has to be distinguished also in children from sarcoma; this last grows rapidly, does not fluctuate, though it is soft, and its surface is nodular or irregular. See PHARYNX, Tumours of the.

Treatment.—Retro-pharyngeal abscess should be evacuated as soon as possible. The old method with trocar and canula through the mouth is for many reasons unsatisfactory. A vertical incision into the tumour, with a bistoury guarded up to its point with sticking-plaster, is easily made, but the left forefinger must hold down and push back the tongue at the same instant, so as to force the epiglottis over the laryngeal aperture, or the first gush of matter may enter the windpipe. When pointing, the finger-nail has been employed to open the abscess. As in other wounds made in the oral cavity, there is but little risk of septicæmia; yet, if desired, the abscess can be opened aseptically by dissecting down upon it behind the sterno-mastoid, and thrusting dressing-forceps into it. See ANTISEPTIC SURGERY. The simpler plan of opening it in the mouth has the advantage of easily allowing a sequestrum to be removed. The writer does not think the advantages of the external method commensurate with its difficulty of performance and more serious character.

C. HILTON GOLDING-BIRD.

RHEUMATOID ARTHRITIS. See CHRONIC RHEUMATIC ARTHRITIS; OSTEO-ARTHRITIS.

RHINOPLASTY.—Under this heading is included a number of plastic operations performed for repair of the nose, in cases of deformity and partial or total loss of that organ. The disfigurement requiring an operation of this kind may be the result of congenital malformation, of injury, or of surgical operation, but in most instances is due to syphilitic, tubercular (lupoid), or cancerous ulceration. The disfigurement, in severe cases of the latter class, is caused partly by destruction of more or less of the nose, and partly by contraction of cicatricial tissue. Although the most favourable conditions for the success of a plastic operation are presented by this region, still the results of rhinoplasty are not usually very satisfactory. The soft parts around the nose are very vascular and well-organised, and thick flaps composed of several layers of varied tissue may be brought over the defect from almost every quarter; but notwithstanding this, it too often happens that, as was pointed out by Denonvilliers, a repulsive deformity has been converted into one that is ridiculous. It has been asserted, however, that the loss of smell and taste, caused by complete destruction of the nose, may be overcome to some extent by supplying a new nose, and there can be no doubt that the patient is thus rendered less liable to attacks of laryngeal and bronchial catarrh. The appearance of a prothetic apparatus of some foreign material is no less unpleasant, especially during transient changes in the vascularity of the adjacent sound parts.

The results of a rhinoplastic operation, with regard to the relief of deformity, will depend much more on the extent of osseous than that of cutaneous loss. If the bones of the nose be preserved, there is always a good chance of restoring a prominent and slightly organ, though most of the skin may have been destroyed. In cases of destruction of the osseous framework of the nose, on the other hand, the surgeon cannot expect to do more than cover the open chasm by a flap, which will remain almost on a level with the cheeks. With regard to the condition of the soft parts, from which it is intended to take one or more flaps, mere superficial cicatrisation would not interfere with the success of the operation. Indeed, scarred skin under certain circumstances, as in the restoration of an ala, would be more suitable material for a flap than skin that is quite sound. When, however, the skin around

the nose has been almost completely destroyed and converted into dense cicatricial tissue, as after a deep burn, the flap would shrink to a considerable extent, and very probably slough. The most unfavourable conditions for rhinoplasty are those in which the nose has been destroyed by syphilitic ulceration or a burn. In cases of destruction by lupoid or cancerous ulceration, by which usually only the soft parts of the organ are destroyed, the prospects of success are more promising.

It has been laid down as a strict rule that, before rhinoplasty be practised for deformity from specific ulceration, an interval of at least six months should follow the disappearance of all signs of active disease. The patient at the time of the operation should be quite healthy, and placed in the best possible hygienic conditions. The complications to be feared during the after-treatment are sloughing of the flap, renewal of the specific ulceration, secondary hæmorrhage, and erysipelas.

For restoration of a completely destroyed nose, the surgeon may transplant a flap from some distant part of the body, as in the old Tagliacotian or Italian operation, or transpose one from the forehead. The former procedure, which, as is well known, consisted in taking a flap of skin from the inner surface of the arm, had from the time of Dieffenbach remained obsolete and of simply historical interest until recently, when it was again performed with much success by Sir William MacCormac in a case of partial loss of the nose with cicatricial deformity of the face, and also by Mr. Hardie of Manchester, who took the flap from the flexor surface of the thumb. The flap has been taken also from the forearm. Though disfigurement of the forehead or cheeks will be thus prevented, the after-treatment in the Italian operation must always be attended with much difficulty, and be found extremely irksome and disagreeable by the patient. The skin of the arm is not so suitable for rhinoplasty as that of the forehead. The primary retraction is certainly very considerable, and, according to Dieffenbach, the subsequent atrophy also was greater in flaps derived from the former source.

In the Indian or frontal operation, performed most frequently by German and English surgeons, a large flap is taken from the forehead and twisted downwards on an inferior attached pedicle, so as to cover the defect. In the first stage of this operation, a commensurate model of the new nose is formed of stiff paper or cardboard, which is

then flattened out on the middle of the forehead. A flap of the same shape as the flattened model, but larger to the extent of a quarter of an inch in every direction, is next mapped out by a deep incision down to the pericranium, and dissected away until it is attached merely by a narrowed root near the internal canthus, on one or the other side. The broad base of this flap usually falls just within the region of the hairy scalp. The hæmorrhage from the large wound thus formed having been arrested, the edges of the defect are pared, except below near the lip, the whole thickness of the soft parts being divided. In this dissection the knife should be carried obliquely from without inwards, so as to cut away more of the deeper portion of the skin than of the surface, and to form a shelving wound around the nasal orifice. This is usually the second stage in the operation, but some surgeons commence by refreshing the edges of the defect, and afterwards take up the frontal flap.

In the third stage, the triangular flap, still attached by its pedicle, is twisted outwards, and then brought downwards, over the defect, to the pared margins, to which its edges are fixed by sutures. The edges of the large wound in the forehead are next approximated by needles and twisted sutures. The columna of the new nose may be formed, either by a narrow process of skin extending from the broad base of the frontal flap, or by a separate tongue-like process cut from the middle of the upper lip, and turned upwards to be fixed by its free end to the tip of the new nose, whilst the other extremity remains attached near the lower margin of the nasal orifice. The lower edge and the alæ of the new nose are elevated at first by pieces of lint, and afterwards, during the healing process, by metal or 'gum-elastic' tubes. The seat of operation should be covered by some simple dressing, and over this a thick layer of cotton-wool. After an interval of six weeks, when the circulation in the new nose has been established, and œdema and signs of congestion have disappeared, the pedicle may be divided, and some small plastic operation be performed for relieving the deformity caused by its prominence.

The best material for the sutures used in this operation for fixing the flap is fine silver wire. Silk often causes some slight sloughing around the punctures, and cat-gut soon becomes soft, and either melts or gives way. The use of stout needles, with the object of elevating the flap, is liable to

cause too much traction on the tissues around the defect, and also to interfere with the circulation in the new nose.

The chief source of failure in this operation is obstruction to the blood-supply of the transposed frontal flap, through torsion of the pedicle. With the view of reducing this torsion as far as possible, many modifications have been proposed in the position of the pedicle and also of the flap. Lisfranc held that one of the incisions limiting the pedicle should be carried half an inch lower than the other, so as to reach almost to the upper margin of the defect; whilst Langenbeck forms the pedicle to one side of the median line, and commences the two incisions just above the internal canthus. Other German surgeons carry the outline of the whole flap more or less obliquely across one side of the forehead, and, in extreme forms of this modification, the long axis of the flap is almost parallel to the line of the eyebrow.

The inclusion of periosteum in the frontal flap, as practised by Langenbeck and Ollier, with the object of rendering the new nose more prominent, does not seem to have been followed by very good results; and, as was pointed out by Serre of Montpellier, might excite inflammatory mischief in the frontal bone, and even give rise to some encephalic complication.

Ollier has endeavoured to impart a good shape to the new nose formed by a frontal flap, by transplanting, in connection with this flap, one of the nasal bones; and instances have been recorded in which Hardie of Manchester, and Sabine, an American surgeon, practised the Italian method, and transplanted the last phalanx of the forefinger.

Rhinoplasty by transposition of lateral or facial flaps—a method to which much attention has been paid by French surgeons—will be found suitable in cases in which the upper part of the nose remains intact. This plan of operation, which is a very old one, and was described by Celsus, has of late years undergone a great variety of modifications. Its simplest form is presented by the operation practised by Syme, which consists in taking two flaps of skin from the cheeks, uniting these in the middle of the face by three or four sutures, and then fixing the outer edges on each side to the raw surface, at a proper distance from the nasal orifice. The wounds of the cheek admit of being nearly closed by a stitch through the edges of each, and what remains of them is of use by the contraction of the granulating process depressing

the hollow at the side of the nose, and thus increasing its apparent elevation.

In Nélaton's operation, two thick flaps, each with a pedicle attached near the lacrymal sac, are brought downwards and inwards over the defect, and stitched together in the median line. In making these flaps, the periosteum is removed from the nasal process of the maxillary bone, so that the resulting scar may be dense and closely attached to the bone, and so rendered incapable of dragging on the new nose. A further attempt to prevent flattening of the organ is made by passing a stout needle through both alæ, and compressing these by the action of a weak metallic spring. In the many modifications of this method, the shape and direction of the flaps are much varied. In some cases, the soft parts of the face have been simply glided over the defect after free separation from the subjacent bone. The chief objections to the so-called French method of lateral flaps are the severe primary hæmorrhage, the risk of secondary hæmorrhage, the disfigurement caused by a linear cicatrix in the middle line of the new nose, and the tendency in the organ to become flattened through tension of the soft parts of the cheek.

A combined frontal and facial rhinoplastic operation, first proposed by Verneuil and practised in this country by Mr. F. Mason, consists in turning down over the defect a frontal flap with its raw surface outwards, and covering this by two flaps taken from the cheeks.

In 1867 Mr. John Wood reported a case, in which he had formed a new nose by taking a broad flap from the upper lip. This, after it had been elongated by separation of the cutaneous and mucous layers extending as far as, but not through, the border of the lip, was turned upwards and fixed by sutures to the upper margin of the nasal defect, and, finally, its anterior raw surface was covered by lateral flaps taken from the cheeks.

In cases where but one or both alæ have been removed by injury or ulceration, a flap may be taken from the sound portion of the nose. Where one ala has been removed, the flap is usually taken from the opposite side, and where the end of the nose has been destroyed on both sides, a square flap has been taken from the bridge and turned downwards, with the epidermic surface directed towards the nasal cavity. In cases of this kind, a flap may be taken from the upper lip or even, as proposed by Michon, from the mucous membrane of the nasal septum. Almost innumerable modi-

fications of the rhinoplastic operation by nasal flaps have been devised by Dieffenbach, Langenbeck, Denonvilliers, Busch, and others.

When the nose has been partially removed by injury or surgical operation, immediate rhinoplasty is not, as a rule, indicated. According to Verneuil, in cases of removal of a portion of the skin without perforation of the cartilage, in which the loss is not excessive, the surgeon should leave the wound to heal by granulation, and not attempt immediate union or cover it by a cutaneous flap.

Several operations have been devised for the relief of the disfigurement caused, in cases of destruction of the bony framework only, by depression and flattening of the soft parts of the nose. The aim, in most of these procedures, is to raise and approximate the two wings of the nose after vertical incision of the organ itself, as in Dieffenbach's method, or after extensive separation of the attached margins of the organ and of the soft parts of the cheeks from the subjacent bone, as in the modification devised by Sir William Fergusson. In the latter operation, the *alæ* having been separated from the parts beneath, and the knife carried on each side between the skin and the bone as far as the infra-orbital foramen, two long needles were passed through the nose from one cheek to the other, and their ends twisted over a small piece of leather applied on each side, so as to cause the cheeks to come closer to each other, and thus render the nose prominent.

In cases of abnormal shortening of the nose from imperfect development, Weir of New York proposes to make a free incision in the soft parts across the middle of the organ, and then, after drawing down the lower part, to fill up the large gap thus formed by flaps taken from the cheeks.

W. JOHNSON SMITH.

RHINOSCOPY.—Inspection of the nose—rhinoscopy—may be practised from the front (anterior rhinoscopy), or from behind (posterior rhinoscopy). For both methods of examination, to make them successful and complete, good illumination and gentle handling of the instruments are essential, even more so than in laryngoscopy.

ANTERIOR RHINOSCOPY.—To obtain a good view of the anterior parts of the nose, direct or reflected rays of light must be thrown into the patient's nose in the manner described in the article on **LARYNGOSCOPY**. The relative positions of the surgeon, the patient, and the source of light,

and the methods for illuminating the parts, are identical with those described in that article. Dilatation of the nostrils is necessary for complete examination of all the parts accessible to inspection, and to effect this, innumerable nasal specula have been invented. The writer has found B. Fränkel's fenestrated instrument, and the longer variety of Duplay's cone-shaped bivalve speculum, both of which are provided with a screw arrangement to open the blades, most serviceable, and, indeed, sufficient for all ordinary purposes. The former is especially useful for examination of the anterior and lower, the latter for inspection of the upper and posterior parts of the nose. The patient's head being slightly inclined backwards, the speculum is to be gently introduced into one of the nostrils (which must have been well cleaned previously); its blades are to be opened, by turning the screw to as full an extent as possible without hurting the patient, and light is then thrown into the cavity, either directly, or from the frontal mirror attached to the surgeon's forehead. When a sufficient view has been obtained of the parts which are immediately in sight, the operator, whilst retaining the speculum with one hand in the nostril, places his free hand on the patient's vertex, and by gentle pressure causes him to bend his head in any desired direction, slightly downwards, upwards, to the right and to the left, the inspection being continued meanwhile. This is necessary in order to obtain a view of all that is really visible, and it is more advisable to direct the movements of the patient's head by touch than by words, in order that the movements may not be too sudden or too violent. After completing the inspection of one nostril, the other is examined in the same manner.

The appearances vary very considerably in different cases. The larger part of the septum, which but rarely appears as a thoroughly straight vertical plate and is more frequently deflected into one or even both nostrils, can be satisfactorily brought into view. The colour of its mucous membrane is, usually, yellowish-red. The lower turbinate bone, which is the most conspicuous object after introduction of the speculum, appears as a bright red, oval or nearly semi-globular bulging, the floor of the nose as a rather flat or slightly excavated groove. The anterior part of the middle turbinate bone can mostly, but not always, be brought into view by the patient bending his head slightly backwards, and in exceptional cases a small part of the

upper turbinate bone may be seen. In cases of ozæna, when considerable atrophy of the lower turbinate bones has taken place, it is often possible to look through the nose into the naso-pharyngeal cavity, and to observe the play of the tubal muscles. Professor Zaufal has lately devised long funnel-shaped nasal specula, which are intended to render such inspection, as well as examination of the posterior parts of the nose and certain operations, possible in all cases.

The frequent irregularities of the configuration of the interior of the nose, the physiological deviation of the septum, the common occurrence of exostoses, &c., often make it rather difficult for the beginner to correctly interpret what he sees. Practice alone can lead to more precise information. Examination by means of the blunt nasal probe, under the guidance of the eye, ought under all circumstances to complete the results of mere inspection.

POSTERIOR RHINOSCOPY is an excellent, though not always applicable, adjunct to digital exploration of the naso-pharyngeal cavity. Its method consists in the introduction into the patient's mouth and behind the soft palate of a small laryngeal, or, as it is called here, rhinoscopic mirror, with the reflecting surface upwards, when, after proper illumination of the mirror, a reflected image of the parts above will appear on its surface. Simple as this proceeding appears to be, it is in reality sometimes very difficult. Much depends upon the co-operation of the patient, and this is not always easy to obtain. The better educated and less nervous the patient, and the larger his pharynx in its antero-posterior diameter, the more easy will be the examination. The main difficulties dependent upon the patient are threefold—(a) involuntary retraction of the velum towards the posterior wall of the pharynx (usually associated with too forcible an opening of the mouth and faulty breathing, or involuntary arrest of respiration); (b) refractoriness of the tongue, the middle and posterior parts of which constantly arch upwards; (c) excessive irritability of the palate, uvula, and posterior wall of the pharynx, causing spasmodic contraction and retching, so soon as these parts are, however lightly, touched. Previous local application of a strong cocaine solution—the writer uses by preference a 20 per cent. solution—will entirely overcome the last-named difficulty. With some practice and patience, however, such application will generally be superfluous. It is essential to teach the

patient to breathe as quietly and naturally as possible *through the nose*, the object of this being that the soft palate should be entirely relaxed. This is indispensable for the success of the examination. A great many palate-hooks, uvula-nooses, and elastic tractors have been invented, with the object of forcibly drawing the soft palate forward, and thus laying the naso-pharyngeal cavity open to inspection. In some very tolerant individuals they may be useful; in almost every case, however, in which posterior rhinoscopy is at all possible, more will be obtained by patience, gentleness, and repetition of the examination, than by artificial means.

The relative positions of the patient, the surgeon, and the source of light are the same as in laryngoscopy. The patient is told to open his mouth, to keep his tongue in, and to breathe quietly through his nose; forcible respiration is as much to be deprecated as holding of the breath. The surgeon now introduces the warmed rhinoscopic mirror, the reflecting surface of which (not more than about five-eighths of an inch in diameter), is directed upwards to the right or left side of the uvula, into the pharyngeal cavity proper. He must guard carefully against touching the posterior part of the tongue, the velum palati, the palatine arches, and the posterior wall of the pharynx. Instead of a small laryngeal mirror, Michel's rhinoscope may be used. In this instrument, the angle of the mirror to the shank can be changed to any desired extent by a spring in the handle, while the shank remains perfectly immobile. The light is thrown on the rhinoscope from the frontal mirror or other source of illumination. The writer's electric rhinoscope (see *Lancet*, March, 1885) dispenses with the difficulty of the last-named proceeding. If a laryngeal mirror be used, its shank will usually answer as a tongue-depressor, but, in some cases, it will be better to gently but firmly depress the tongue with a spatula held in the operator's left hand, whilst his right hand directs the rhinoscope.

A complete inspection of the naso-pharyngeal cavity can only be made by altering the position and slanting the mirror, the rhinoscopic image being a compound picture. It will often be necessary to introduce the mirror several times, before this purpose is achieved.

When the mirror is held more in the vertical position, the choanæ, or posterior nares, come into view. The posterior aspect of the nose shows in its middle the septum, forming a thin, straight, almost white pro-

jection, which above passes over, in the form of two symmetrical Roman arches, into the vault of the pharynx. It is of practical importance to know that these arches are visible in every normal rhinoscopic image; should they not be seen, this proves that they must be obscured by some abnormally developed tissue. On both sides of the septum the posterior ends of the three turbinate bones appear, the middle bone being the most conspicuous. Their configuration is somewhat variable; the superior turbinate bones are rather horn-shaped, the middle oblong, the lower rounded. Their colour, on the whole, is pale, especially that of the middle turbinate bones. Between them are visible, more or less distinctly, the three nasal meatuses. When the mirror is held in a more horizontal position, the vault of the pharynx comes into view. Its appearance is often rather irregular and rough, owing to the adenoid tissue by which it is covered. On slanting the mirror, held at an angle of about 130° to the horizon, and inclined towards one side, the internal opening of the Eustachian tube, with its folds of mucous membrane, and Rosenmüller's fossa come into view. Below and in front, the upper surface of the velum, in the middle of which the so-called 'uvula cushion' is visible, forms the lower border of the rhinoscopic image. FELIX SEMON.

RIBS, Fractures of the.—These are among the most frequent of all bone-injuries, forming about a tenth of all the fractures we are called on to treat. They are more common in the male than in the female, on account of the greater exposure of the male sex to violence; more frequent in the middle-aged and old than in young people, on account of the greater elasticity and softness of the bones in the young; and they occur more often about the seven upper ribs than in the five lower, on account of the more rigid way in which these ribs are connected to the sternum. In children, the fracture is very often incomplete from the way in which the rib is driven inwards; in such cases, the part of the rib towards the pleura may be fractured, while the outer part remains intact. In this way, damage to the pleura may sometimes arise, while the rib remains apparently intact.

The ribs are most commonly fractured by the application of some strongly compressing force. When the force is applied over a small surface, the fracture is said to be by direct violence, as takes place when a rib is fractured by the blow of a rope's end, or

of a fist, or when the body falls upon some projecting point. When the force is applied over an extensive surface, as when the ribs are fractured by a wheel passing over the chest, which thus caves in, the fracture is said to be by indirect violence, the rib in this case fracturing at a distance from the point where the violence is actually applied. The distinction is only of importance in relation to the number of ribs fractured. In fractures produced by indirect violence, the number is likely to be much greater than when produced by direct violence. On the other hand, direct violence is apt to drive the end of a single rib further into the cavity of the thorax, and thus is more likely to damage the thoracic viscera. Fractures of the ribs are also produced by muscular action, as in the act of coughing or sneezing. It is possible that some of the apparently spontaneous rib-fractures of old people are produced in this way.

The number of ribs fractured depends very much upon the nature of the injury. In fracture produced by direct violence, only one side of the body is generally affected; in those produced by indirect violence, one or both sides may be affected, and a rib may even be broken in two places. Fractures of the ribs are scarcely ever compound, except from gun-shot injury.

The *symptoms* of a fractured rib are often rather indefinite. There is pain at the seat of fracture, undue mobility, detected principally by pressure upon the end of the rib, and crepitus, which is often difficult to detect, but which is best done by placing the hand over the chest and making the patient breathe. In this act, a little alternate pressure and relaxation of the hand will often make the crepitus apparent, when it is otherwise difficult to make out; or it may be detected by placing the ear or stethoscope to the chest, and causing the patient to take a full inspiration. Difficulty in breathing and coughing, and more or less 'stitch in the side,' are also commonly present. The respiration is mostly diaphragmatic. The cough is very peculiar; it is slight and suppressed but frequent, and troublesome from the pain caused by it. This pain is probably due to some irritation of the intercostal nerve at the seat of fracture.

Fracture of the ribs is often complicated by damage to the internal viscera. The pleura is the part most frequently injured, and after this the lung. But many other parts are also occasionally damaged. Thus, a case is on record in which a single rib

was fractured by the end of a rope flying loose. The fractured piece was driven in through the pericardium and pierced the apex of the heart, causing almost immediate death. The diaphragm and liver are not infrequently damaged by fractures of the lower ribs, the spleen less frequently so, unless enlarged into an 'ague-cake,' while fractures of the eleventh and twelfth ribs may rupture either the ascending or descending colon. Injuries to the pleura and lung give rise to hæmothorax and emphysema, more or less general. *See EMPHYSEMA; HÆMOTHORAX; LUNG, Wounds of the; PERICARDIUM, Wounds of the, &c.*

Treatment.—The object of the treatment should be to immobilise the fractured ribs, so as to put them in the most favourable state for repair. This is best done by fixing broad bands of adhesive strapping (about two inches wide) from the sternum to the spine. These bands should overlap freely, so that a fair *thickness* of plaster be formed, thus acting as a kind of splint to the side of the chest, causing it all to move together in the act of respiration. If many ribs are fractured, and it is desirable to form a more solid splint or mask for the side of the chest, one or two thin pieces of light wood may be placed outside this strapping at right angles to the course of the ribs, and united to the layer of strapping beneath by other layers laid on superficially to them. This aids in making the whole side of the chest move as one piece, and is especially useful, combined with pads, where the fracture is depressed, and it is thought desirable to attempt to lift the depressed ends out of the chest. Some surgeons prefer to put a single piece of strapping over the whole of the side of the chest. This, however, never fits to the surface as well as the strips, and, if more thicknesses than one are considered desirable, it cannot be laid on so uniformly. Some surgeons, again, prefer to make the strips of plaster surround the whole chest, and some apply a bandage moderately tightly round the chest, even in cases where only one side is injured. This plan has the disadvantage of limiting the movements of both sides of the chest, whereas it is for the comfort of the patient to leave the respiratory movements of the uninjured side as free as possible.

The use of the bandage, though common, is in some cases not absolutely free from risk. Flannel is usually chosen, as being more suitable from its slightly elastic texture. But the writer has seen more than one case in which this rather elastic bandage, from being too tightly applied, has so

compressed the chest that it has caused the fractured ends of the ribs to be driven in, so that they wounded the pleura and the lung. An elastic bandage then should be applied with only very moderate pressure, and may generally be dispensed with altogether. The sensations of the patient may, however, be taken as the best test of its utility. If grateful to him, it is certain it is doing no harm, and may be continued; but if it causes oppression and pain it should at once be taken off. Indeed, some patients cannot bear anything upon the chest, and prefer simply to lie motionless in bed. Other methods of treatment have been used—as, for example, a kind of vest made to fit the body very closely, and to be suspended from the shoulder. This, however, is not so efficient as the plaster method.

Constitutional treatment will be necessary in many cases, where the patient is irritable or suffers much pain. An uncomplicated case of fracture will not generally require anything, but if it be complicated by any damage to the pleura or lung, it may be necessary to give small doses of sedatives, combined with expectorants and diaphoretics. Of these, the following is a most useful combination:—℞ Tinct. scillæ, ℥v.; Vin. ipecac., ℥v.; Tinct. camph. co., ℥xx.; Vin. antimonial., ℥x.; Liq. ammon. acet., fʒss.; Aq. chlorof. ad fʒj. M. Ft. haust. 2ndis horis sumendus.

If the fracture occur in very old people suffering from chronic bronchitic conditions, more stimulant expectorants are required, and carbonate of ammonia (gr. v. doses) with infusion of senega (fʒss. doses) may be substituted for the squill and acetate of ammonia. In such cases, putting the patient into a steam tent is often a very great relief to him. Where there is evidence of much intra-thoracic inflammation in younger persons, leeches may sometimes be advantageously applied to the chest, and even the advisability of venesection be considered. This method of treatment has almost disappeared from practice of late years, but the writer has seen some few cases in which the patient was in a state of great distress, with considerable dyspnoea, oppressed pulse, and much blueness and congestion of the face, in which a moderate venesection most markedly relieved the symptoms.

The *prognosis* in uncomplicated cases of rib-fracture is very favourable. The fracture nearly always unites by bony union, but often a considerable amount of callus is formed, from the necessary mobility due to the act of respiration. Sometimes a case

of non-union will occur, with possibly abscess and necrosis. Such cases generally indicate some predisposing constitutional condition. The prognosis is least favourable in old bronchitic persons. In these patients, a considerable secretion of mucus normally goes on from the bronchial tubes, and this is expectorated by frequent fits of coughing. After a fracture of the ribs, the pain on movement causes the cough to become suppressed, the expectoration of the mucus no longer takes place, and thus accumulation goes on to such an extent as to choke the smaller tubes and lead to death by apnoea. In fractures of the ribs, complicated by injuries to the internal organs, the prognosis depends upon the organ injured. If the diagnosis be doubtful at first, it is safer, for purposes of treatment, to assume that the major injury has occurred, and to treat the patient accordingly, until the diagnosis has become clear from the after-history of the patient. Emphysema occurring after a fracture is not generally an unfavourable sign; it quickly absorbs if left to itself. H. G. HOWSE.

RICKETS may be defined as a constitutional dyscrasia resulting from general malnutrition. It is peculiar to infancy (perhaps to the foetus) as regards its initiatory stages; and, in its later ones, chiefly characterised by changes in the texture, chemical composition, and outward form of the bony skeleton, and by altered function in other organs, transient for the most part, but occasionally permanent. Although the disease has been carefully studied in all its stages, the earliest beginnings are still quite matters of conjecture. Rickets is said to occur 'in every quarter of the globe' (Senator.) The writer has himself seen it in almost every European capital, and in the South African colonies, where the summer lasts nine months, and where overcrowding, fogs, and deficient sunlight are quite unknown. It is especially common among the manufacturing population of Yorkshire and Lancashire; it is found at places on the sea coast, as well as inland. There can, however, be no doubt that rickets is chiefly a disease of large cities, and that its development is favoured by overcrowding, neglect of sanitary and hygienic precautions, and by a cold damp atmosphere, which compels people to shut themselves up in ill-ventilated habitations.

Guérin, Storch, and especially Bednär and Ritter, admit *hereditary influences* in its production, and regard the occurrence of congenital rickets as an argument *ad hoc*.

The writer has seen many cases of direct transmission from parents to children, and at least one case of transmission from the grandparents. The disease, nevertheless, is not generally allowed by clinical teachers in this country to be hereditary. Of 1,000 children under three years of age, including babies in arms, examined in the out-patient department of the East London Children's Hospital—many of whom did not come as patients but simply accompanied their mothers—800 at least bore some traces of rickets; many of these were brought on account of pronounced rickets, but in many others the diathesis showed itself in its less generally acknowledged forms—enlargement of radial epiphyses, slight beading of ribs, late closure of fontanelles, or general backwardness. These children—boys and girls—brought up under conditions (to be presently described) which favour the development of rickets, will grow up, and in due time intermarry. Their children, bred and born under like circumstances, must surely inherit a stronger predisposition to the diathesis than the children of other persons, not so affected in their youth. The growing frequency of the milder forms, and their appearance under surroundings not usually associated with rickets, are only to be explained by this hereditary influence. Jenner 'has no facts to prove that rickets is hereditary'; but, like other authorities, admits that all those conditions which deteriorate the health of the parents, of the mother especially, render the children liable to rickets. Thus, frequent pregnancies, disparity of years in either spouse, advancing years, late marriages, irregular habits of life, acute illnesses, chronic disease (scrofulosis, tuberculosis), inherited syphilis, starvation in the parents—each and all exercise deleterious influences on development of the offspring, which predispose them to rickets. Thus, it is obvious why the poor should not alone suffer from this diathesis; on the contrary, rickets is found among all classes of society, although the advanced and fatal forms are most common among the poor.

The influence of heredity, however, is further proved by the frequency with which many members of the same family suffer, even without the immediate influence of that environment which is known to develop rickets. The absence of any persistent symptoms in the parents is no argument against this view, any more than it would be in the case of gout, or rheumatism, or other disease, the manifestations of which are temporary and generally fleeting.

Period of Onset.—Some of the signs of rickets are not infrequently found in fœtuses (a condition, however, not to be confounded with *fœtal rickets*, which will be briefly considered further on), and still more frequently in children at birth. These signs consist in curvatures of the long bones, with enlargement of their epiphyses; beading of the sternal ends of the ribs, with a tendency to pigeon-breast; an unduly open condition of the fontanelles and sutures, with enlargement of the head. More marked and more generally acknowledged signs have been observed a few weeks later; thus, Gee says: 'Unquestionably beading of the ribs may occasionally be found in infants of only three or four weeks old; at three or four months of age rickets is quite common.' Ritter has described extensive beading of the ribs in an infant of three weeks; Virchow, at five weeks of age. Moreover, he refers to the specimen of a rickety fœtus in the Berlin museum. Henoch also records having seen two children, who were born 'with multiple incurvations and inflexions' of the bones, and with great softening of the entire skullcap. The writer has examined fœtuses with unmistakable signs of rickets, and seen many cases, with well-marked symptoms, in infants of one month and upwards.

When it is considered that one of the earliest signs of rickets—enlargement of the epiphyses, according to some authorities the only pathognomonic sign—is not regarded as disease even by the profession, and that children so affected are not generally brought under treatment, it is not surprising that the published statistics show only about four per cent. of rickets in infants under and about three months of age. A recent analysis, by the writer, of one thousand consecutive cases gave the following particulars as to the asserted period of onset of rickets as usually understood. During—

		Per cent.	
1st year	1st six months	202	20·2
	2nd six months	278	27·8
2nd year	3rd six months	238	23·8
	4th six months	144	14·4
3rd year	.	98	9·8
4th year	.	18	1·8
5th year	.	14	1·4
6th year	.	8	·8

The above figures show how great is the incidence of the disease during the earlier months of life, and they suggest a far-reaching and fairly uniform cause, such as congenital predisposition—heredity—to account for it.

Causes.—Enough has already been said to show how largely the constitutional element, in the writer's opinion, enters into the question of causation. Many authorities, on the contrary, regard *artificial feeding* as the chief, not to say sole, cause of rickets. This latter view, however, is very misleading, and leaves out of consideration those factors which are most potent; improper diet, however, is unquestionably a very powerful cause, and it is most likely to lead to rickets in children who are weakly and delicate from birth. That many children who are carefully suckled and brought up, suffer from the early phases of rickets, is a fact beyond dispute, and that many escape who are fed artificially, and indeed never thrive until so fed, is equally true; we must, therefore, be very chary in attributing rickets to errors in diet alone. Moreover, when several children in a family, one after the other, become rickety, the recognition that this depends on debility in the parents at once suggests prophylactic measures which will save much trouble, and greatly increase a future child's chances of recovery, or even its complete escape from the affection. The particular kind of food which is considered so detrimental to these children is that which contains *starch*—that is to say, all *farinaceous food*. It has been found experimentally, but on an extremely small scale, that neither the saliva nor the pancreatic or enteric juices of young infants (and of many animals) can digest starch—that is, convert it into glucose; hence the inference that the administration of starchy foods to infants is the efficient cause of rickets.

There can be no manner of doubt that many children, who are carefully suckled, get rickets even in its pronounced forms, and as little doubt that many children, who are artificially fed, escape. *Protracted suckling* is a not infrequent source of rickets, and is detrimental alike to mother and child. Indeed, the inducement in very many cases to begin artificial feeding is either (1) a deficiency in the maternal milk-supply, itself not seldom an indication of weakly health; or (2) because the child does not appear to thrive on the breast-milk—in other words, because the child already begins to manifest signs of a deficient assimilative power which is congenital with it. That rickets should begin, in the majority of these cases, so early after artificial feeding has been commenced, suggests a strong predisposition thereto; for it is hardly conceivable that such food as

is usually given to these infants—cow's milk or cooked flour in some shape or other—should be able to produce the universal and often profound changes, throughout the entire skeleton, which are found in infants of quite tender age. The amount of unaltered starch contained in a couple of nursery biscuits, or in a teaspoonful of baked flour, oatmeal, arrowroot, or cornflour, made into pap as given to children, is ridiculously small; and it is begging the question to attempt to explain such a widespread disorder on the hypothesis that this starch, one of the blandest and most universally distributed substances in nature, is the *fons et origo mali*! A large percentage of all the children in whom the osseous system is only, or chiefly, affected appear to be well nourished. 'Only thirty per cent. are really ill nourished' (Baxter). When it is remembered that animals fed on starchy diet die of inanition, it must be confessed that the starch theory of causation has yet to be proved. Of great moment, however, are the privation of fresh air and sunlight, and the influence of unhygienic surroundings during the earliest months of life. Ill-ventilated, overcrowded rooms, the re-breathing of expired air, want of cleanliness, are among the most efficient causes of rickets, even in cases where the predisposition thereto is not very marked.

It has been asserted that rickets is a worn-out syphilitic affection, but there is absolutely no truth in the statement. *Syphilis*—like *scrofula* or like *tuberculosis*—is a factor only so far as it deteriorates the general health of the parents, and so renders their offspring weakly and more receptive to any unhygienic influences to which they may be exposed. Thus, rickets is a disease not due to any one cause, but brought about by many acting in concert. It is largely the outcome of civilisation, which tends more and more to aggregate the population, and thereby to enforce that neglect of personal health in adults, which reproduces itself in the children (among other ways) as rickets. It must be borne in mind that other diatheses may be associated with rickets in the same subject. Thus, syphilis and rickets are constantly seen allied, as also rickets and tuberculosis and scrofula. The recognition of these facts is chiefly of interest in regard to treatment.

Pathological Anatomy.—Glisson and almost all subsequent authorities have drawn attention to the frequent association of pallor of skin, flabbiness of muscles, and special liability to pulmonary and to gastrointestinal catarrh with rickets of the bones,

as indicative of a general disease. Nevertheless, possibly because these lesions cannot be said to be special, pathological attention has been chiefly directed to the changes which occur in the skeleton; and yet, the former are by far the most frequent causes of death. When the osseous system is alone or chiefly affected, rickets seldom proves dangerous to life. Some or all of the following lesions may be found *post mortem*.

Viscera.—The *lungs* are often found emphysematous along their margins, with extensive patches of collapse in their interior; the bronchial tubes are full of frothy mucus, the presence of which, by impeding the entrance of air, leads to the collapse. On section, the adjoining lung-substance may or may not show bronchopneumonic changes. Not infrequently, on their surface may be seen signs of pressure from the depressed ribs: in a few cases, the beading of the ribs (generally most marked on the inner surface) produces a series of depressions, where they have pressed upon the lungs. The *stomach* is generally distended, pale, and bloodless; its mucous membrane is thin, soft, and readily breaks down under the finger; there are often local patches of congestion, with abraded surface in some cases, and tenacious mucus adhering to them. The *intestines* are also thinned and pale; they generally contain undigested food and flatus, as evidence of their want of power and tone; the solitary glands and Peyer's patches are often prominent and congested. The *liver* is sometimes enlarged, now and again the capsule is thick and whitish, and the substance firmer than usual; it is, however, more frequently fatty. The surface may be indented, where the beaded ribs have pressed upon it. The *spleen* is more frequently affected, being larger, heavier, and firmer than usual: this is apparently due to a greater or lesser degree of hyperplasia of the connective tissue. There is no reaction with iodine. Occasionally 'white patches' are found on its capsule. It must be stated, however, that changes in the abdominal organs are comparatively rare in the post-mortem room, and that children may suffer severely from rickets in whom no such or other visceral changes can be found.

Nervous system.—Although rickety children are unusually prone to nervous disorders, no pathological changes, except perhaps a slight increase in the cortical white matter in some cases, have as yet been discovered to account for them; in a few cases, the brain-substance is softer, and the ven-

tricles contain more fluid than normal; whether this is the result of a chronic change—part of a general catarrh—or is merely a compensatory transudation, it is impossible to say. There is no abnormal change in the *heart* or *vascular system*. ‘White patches’ are very common in children whose chests are deformed from rickets (Wilks); and appear due to friction against ribs projecting inwards: the ‘chosen seat’ (Jenner) is on the left ventricle, a little above its apex; the heart-muscle examined in a severe case, fatal from gastro-intestinal and pulmonary catarrh, showed no appreciable deviation from the normal. The writer, in conjunction with Mr. Shattock, examined the blood in nine living cases of rather severe rickets. In eight of the cases the number of the red corpuscles was in excess of the standard, in one case as much as 24; in the ninth case the number was reduced, as from 5 to 3; this blood, when drawn, looked very thin and ‘hydræmic.’ In most of the cases, the discs varied considerably in size and in shape, some being thorn-apple and some crenate; nor was anything, not found in healthy blood, observed. There were no nucleated discs. The granule-masses observed likewise presented nothing remarkable: the colourless corpuscles varied in size as in health; in one case only was there any excess. This negative result is not without interest, in a disease which affects the bones so profoundly, in view of the part which the marrow of bones is said to take in the formation of the blood. It is difficult to say how far any of the foregoing visceral lesions are specific, or whether they are merely accidental complications; their frequent association, however, suggests that they form an integral part of the disease. The occurrence or absence of one or other symptom is only in keeping with the clinical experience, that a general disease may occasionally show itself in one tissue more severely than in another.

Osseous system:—Although variable in amount and at different stages of the disorder, the condition of the bones, especially at the epiphysial junctions, both to the naked eye and under the microscope, is the only one which is constantly present and at all pathognomonic of rickets. The *chemical composition* of the bones presents some striking deviations from the normal, the causation and significance of which, however, are differently interpreted by different authors; analyses of other tissues, with a view to establish whether they too present any variations from the normal,

will have to be made on a large scale, before it can be settled whether the changes found in rickety bones are the essence or the consequence of the disease. Friedleben’s admirable researches show that the metabolic processes are particularly active in the osseous system of *all* infants during the second half-year of life; and that the chief chemical changes consist in an increase of the organic elements and a diminution of the earthy salts. This is just the period at which also some of the most characteristic of the so-called rickety changes occur, these latter changes being almost identical in kind, but greater in degree. According to this author’s observations, the general chemical characters of rickety bones may be thus summarised: diminished quantity of the earthy salts, most marked when the disease is at its height, nearer the normal in the older bone layers, far below normal in the newly-formed (osteoid) parts, and in the latter an increase in the carbonic acid; little difference in the amount of fat, with the exception of the long bones, where it is increased in quantity by the marrow contained in the spongy parts, and in the enlarged medullary canals. The specific weight is lessened in proportion to the extent of the affection. The organic framework undergoes no obvious change, but the unossified cartilage contains more water. The grosser changes consist in peculiar and characteristic alterations in shape, and sometimes in consistence; all the bones, or only some few, may partake in the changes. The flat bones appear to suffer markedly.

In the *skull*, a condition termed *cranio-tabes*, first described by Elsässer, is frequently found to exist. The cranial vault becomes so thin and soft that it yields to the pressure of the finger; sometimes the bone is no thicker than parchment, and crackles when pressed upon. This condition may be confined to small areas, or involve the greater part of the parietal and upper part of the occipital bones, being generally found most marked in the posterior segment of the skull. In the healthy condition, even at birth, the cranial bones although very thin are nevertheless quite firm, and capable of resisting great pressure. *See CRANIO-TABES*. Elsässer distinguishes this softening from actual perforations (which are congenital defects), and from similar conditions associated with hydrocephalus, cephal-hæmatoma, inflammatory changes, and the like. Though found in other diseases, there can be no doubt that cranio-tabes is a sign of rickets *par excellence*: it is rarely found

after the twelfth, and occurs most frequently between the third and fifth months. In other cases, the cranial bones are much thickened owing to proliferation beneath the pericranium; unlike thickening of the long bones, which is more or less uniform, this occurs in patches or along the margins. The thickening may be very considerable and very localised: it differs from healthy bone in being soft and porous. At the sutures and fontanelles, which are the equivalents of the epiphyses, ossification goes on very irregularly; the sutures often become much thickened and sometimes project beyond the level of the adjoining bones. The interior of the skull-bones does not present any abnormal change; the dura mater is always very adherent.

The *scapulæ* and *pelvis* are hypervascular, coarsely porous like pumice-stone on the surface, but possess a central, thin, firmer layer of normal bone; this outer deposit may have a distinct lamellar construction, and contains more marrow and less earthy salts than normal cancellated bone. Along their margins the bones are much thickened. The pelvic bones, from their position and the weight which is transmitted through them, often undergo important deformations, the permanent effects of which, in adult women, may interfere seriously with child-bearing. The *clavicles* become acutely bent (a condition which may be easily mistaken for fracture) just outside the attachment of the sterno-mastoid and pectoral muscles. The *ribs* often suffer greatly; normally they are more vascular than the other long bones, and are long in proportion to their size. Virchow teaches that the predisposition of certain bones to manifest rachitic changes stands in direct relation to their physiological use. It will be conceded that the ribs are constantly in use. There are two spots at which rickets manifests itself chiefly—viz. between the tubercle and the angle (which is often greatly thickened): at this spot in acute rickets infraction (spontaneous fracture) may not infrequently be found; secondly, at the anterior end. In cases of chest-deformity in infants, the tip of the rib is bent acutely on itself, the cartilage taking no part in many cases. So-called 'beading' of the ribs results from the proliferation which is going on at the costo-chondral junction; the expanded cartilage appears in some cases to fit on the rib like a cap, the enlargement being generally more marked on the inner than on the outer surface. The chest-deformities of later childhood are different, and follow no

regular type, being dependent on, and modified by, the effects of partial repair, of occupation, and of dress.

The *long bones* present certain pathological appearances on their surface, and along the epiphysial lines, which may be summed up as follows. The periosteum is everywhere thickened; it separates more readily than normal, owing to an unusual amount of newly formed hypervascular soft bone on the surface of the shaft; to its under surface, when so separated, will sometimes be found attached minute needle-like spicules of young bone, which have broken away from the shaft. On making a vertical section through the epiphysial junctions, the proliferative zone will be found increased from about half a line (as a normal) to as much as six lines or more in severe cases; and instead of being straight, it presents an irregular outline—that is to say, the cells are not arranged in rows as seen in normally ossifying hyaline cartilage, but are scattered irregularly over the whole ossifying area. The ossifying centre in the epiphyses is larger than usual, and is often of a *diffuse* character (Sutton). The changes consist in an increase, with deficient and irregular ossification, of the cell-proliferation, in the persistence of thickened cartilage-cells in these deficiently ossified layers, and in the formation of numerous small medullary spaces, even in the still unossified cartilage. The long bones undergo marked and quite characteristic deformities, which are usually attributed to a process of softening, and said to be part of the rickety process. On this point Glisson says: 'And first we flatly deny that the bones of children afflicted with this disease are more flexible or less stiff and friable than the bones of others.' The writer has osteotomised many deformed rickety bones in children from three to ten years of age, and has always found the bones remarkably hard; moreover, in the post-mortem room, he has never seen bones *presenting the ordinary rickety curves* in a soft stage, nor have any such specimens ever been demonstrated at the Pathological Society. If the bones were really softened, it seems hardly probable that the resulting deformities would be so uniform as they actually are in practice, while the fact of their spontaneously becoming straight without again softening, suggests some other explanation. The pathology of rickety bones varies of course with the age of the patient, and the stage at which they are examined; if the process is in full vigour, there will

be signs of increased activity, while later the appearance will be one of sclerosis and enlargement. Although spinal troubles are not infrequently complained of, there are no changes in the *vertebræ* which can be said to be characteristic: sometimes they are excessively spongioid, so that they may be cut with a knife (Barlow); the deformities in the vertebral column as a whole are chiefly due to a relaxed condition of the ligaments. Indeed, throughout the body, the *ligaments* suffer more than is generally recognised; they are nearly always more yielding, and as a consequence longer than in health.

Symptoms.—The onset of rickets may be so rapid as to deserve the term ‘acute.’ More commonly it is slow and gradual; indeed the earliest symptoms of the usual form generally escape observation, and rickets may long since have passed its initial stages, before it is noticed either by the child’s parents or even by the doctor. It is very difficult to say what constitutes the first departure from the normal standard in many cases: a somewhat large head, with widely open fontanelles, profuse perspiration about the head, a dislike to sleep covered up, are common occurrences among well-fed, firm-fleshed infants at the breast, and yet the foregoing are signs *par excellence* of the rickety disorder. Presently, the epiphyses, markedly those of the lower end of the radius, begin to enlarge, and in time the child becomes ‘double-jointed.’ In many cases Elsässer’s soft patches on the skull-cap (craniotabes) will be among the earliest symptoms; they are especially frequent in babies with thin, lank hair. In other cases the chest becomes deformed—prominent along the sternum, and sunken in along the costo-chondral junctions; the tips of the ribs will be found ‘beaded;’ dentition is irregular rather than late, as generally stated, or both; sometimes the spine grows out, and the child cannot sit up, or is altogether backward for its age. The ligaments may be loose, and the knees or ankles, or both, ‘give in’ whenever the child attempts to stand or walk. In the earlier months of life, rickety children are especially liable to catarrh of the bronchial and gastro-intestinal tracts; hence bronchitis, with its sequel of collapse, is common; or a weak and easily disturbed digestion, indicated by vomiting, diarrhoea, and offensive stools, will be the sign which betrays the disease. ‘Rickets is not a cause of pyrexia; if the temperature rise above the normal level, a complication may at once be suspected’ (Eustace Smith).

Convulsive disorders are a frequent and often the only morbid manifestation of the rickety diathesis; they are most common in children under two years of age, and belong to the earlier stages of rickets. These convulsions are usually said to be reflex; laryngismus stridulus and carpo-pedal contractions are practically confined to the subjects of rickets. Tetany also is closely associated with rickets (Abercrombie), and some cases of strabismus are due to the same cause; indeed, not less than two-thirds of all the convulsive attacks to which children are liable will be found due to, or associated with, rickets. In a few cases there is great tenderness; the child objects to being handled, and cries when it is raised up. Such are the clinical signs of rickets, varying a little with the period of life when the diathesis begins to make itself prominent, and with the organs or system chiefly or first attacked. The antecedents, or some of them, to which reference has already been made, on inquiry will almost certainly be made out. Occasionally, fidgetiness and ‘growing-pains’ point to the onset of rickets, or the bone-deformities come on more or less rapidly without an apparent cause.

As regards *individual symptoms*, it may be said that the *facies* is almost characteristic. There is a disproportion in size between it and the head; the latter tends to become square; the frontal eminences are large and prominent, and the sutures thickened and often distinctly elevated; on palpating the head it feels hard and lumpy. The teeth are said to be less durable than in healthy children, and the alveolar processes altered in form; but these symptoms are not very reliable or well-defined. There is a great tendency to sweat profusely about the head, which is very suggestive, and, as if they felt hot, these children throw off the bedclothes at night and prefer to sleep uncovered. The abdomen is generally prominent; the chest is nearly always flattened at the lower lateral parts, and more so on the left than on the right side; at the junctions of the ribs with their cartilages there is often ‘beading.’ The spinal column may be affected or not; owing to flabby muscles and loose ligaments, and sometimes to the weight of a larger head than normal, the child cannot sit up firmly; the spine then forms a curve, either backwards or laterally—the direction being determined by the posture which the child most frequently maintains. The deformities of the long bones may be said to differ within rather narrow limits; they

are very similar one to another, and so generally symmetrical that an affection of one side alone would bring the diagnosis into doubt. The tibiæ, of all the bones, are perhaps the most frequently affected; the 'seat of election' is in the lower third, and the common curve is outwards and forwards. In a few cases the stress falls on the crest of the shin, which becomes prominent and sharp and curved. The fibula doubtless participates in these deformities, but from its deep position they are less manifest. The femur is less frequently affected; the commonest curve is in the upper third, and in direction outwards and forwards; in the lower third it curves inwards, and so contributes to the formation of knock-knee. The bones of the arms suffer markedly in a few cases, the humerus suffering more frequently than the bones of the forearm. The ligaments are nearly always flaccid, temporary knock-knees and flat-foot resulting in many cases. Rickety children generally grow slowly, they are large-boned, and their stature is often stunted.

Prognosis.—The prognosis in individual cases will vary with the child's age, the stage of the disease, and the absence or presence of complications. In uncomplicated cases a good prognosis can be given with confidence. By far the commonest cause of death is pulmonary or gastro-intestinal catarrh. The tendency to these diseases lessens as age advances, but they are very fatal to young children. A few children die of the nervous complications, either of convulsions or of laryngismus, especially when their origin in rickets is not recognised. As regards the deformities, it may be said that in ninety per cent. all traces disappear in process of time; in a few, permanent deformity of the bones remains. The thorax, especially, never quite regains its normal shape, if deformity has once been marked; and the same may be said of the skull. But in all other respects the children grow up strong and well, though it may be that their stature is somewhat dwarfed.

Treatment.—A consideration of the causes, just enumerated, which combine to produce rickets will suggest prophylactic measures of great value; for, whatever strengthens a woman's health strengthens that of the child she may be carrying or suckling, and whatever tends to deteriorate the mother's health, either before or after parturition, predisposes her child to rickets. The causes, among the rich late hours and various social exactions, among the poor the debilitating influences of poverty, must

be removed as far as possible, and a rational mode of living be insisted upon by medical men for all pregnant and suckling women, rich and poor alike. A large proportion of infantile mortality is directly due to causes acting on the children antecedently to their birth, combined with unsuitable food and attention subsequently. There can be little doubt that the best diet for an infant is its mother's milk, and any conditions or surroundings which tend to lessen either the quantity or the quality must be avoided. The cases in which mothers' milk is likely to be injurious to their own infants are extremely few; the writer doubts very much whether a mother can convey to her own child through the milk any constitutional taint or weakness, which it has not already inherited *in utero*. The excuses for not suckling children are often really trivial, and should be discountenanced by the medical attendant; the health of the mother is improved and her tendency to disease in the breast lessened by suckling, the temporary inconvenience being more than neutralised by the advantages which the proper carrying out of the physiological functions in the breast, entailed by child-bearing, brings with it.

Rickets is essentially curable, and cod-liver oil is the remedy for all forms of the disease. It should be given in doses of one teaspoonful or less, alone, or combined with either steel-wine or lime-water. Very few children fail to become reconciled to it, with perseverance on the part of their parents; when given alone, a teaspoonful of orange wine, or black coffee, or milk, forms an excellent vehicle, and a nicely flavoured lozenge removes the taste afterwards. Its use must be continued for some months, with short intermissions, and it is most useful when given shortly after food for it is then mixed, digested, and absorbed along with the food. Judicious management of individual symptoms is of course necessary. If an infant is suffering from the effects of an improper diet, improvement cannot be expected so long as this diet is continued. On the other hand, let it be ascertained whether *too much* food is not being given, and *too often*, before it is said to be improper. In a few cases the mother's milk distinctly disagrees: this may be a radical fault, or depend upon fleeting conditions of health easily remedied. In the former case, some other food must be tried, and given in addition to, or substituted for, the milk. *Fresh milk* (either cow's, goat's, or ass's), suitably diluted according to the age of the child, should

always form a part of the diet; it may be alternated with one or other of the many artificial (malted) foods now in vogue, that one being finally selected on which the child thrives best.

There must be no hard and fast routine diet for all children; what agrees with one may disagree with another, while a little variety is beneficial to all. But in all cases, some *fresh* food—as opposed to the *prepared* foods—must be given. It is not an uncommon error to give the food too strong, and especially so in the case of weakly infants, who do not thrive; the more feeble an infant, the less can it digest complex or strong food; even cows' milk must be diluted more than usual; it may even be well to partially digest it by means of pancreatine before giving it. A fertile source of mischief is an unclean feeding bottle. Even with the best will it is not easy to keep the bottle and the tube thoroughly sweet; under these circumstances it is well to get new tubes and new teats at short intervals. A little pounded raw, lean meat is of great service in many cases, and can never do harm; from one quarter to half an ounce once or twice a day may be given. Fresh fruits, fruit-juice, part of an orange, or a piece of lemon (well sugared) to suck, a roasted apple or pear free from skin and husks, are valuable aids to digestion, even for quite young infants. For older children, green vegetables, lettuce, cress, celery, tender and fresh from the garden, should be given. A pinch of salt with the food must not be forgotten. It is well to avoid tea, coffee, and stimulants.

Next in importance to the food are fresh air and light in the nursery; for the latter a south or south-west aspect is the best; too high a temperature must be avoided, and the air constantly changed. Bathing is of great value to rickety children: with salt water, if it can be procured, if not, with sea-salt dissolved in the bath water as the next best substitute. The whole body should be well sluiced with a bath sponge for a minute or two, and then be systematically rubbed and shampooed; for an infant, and in winter for older children, the bath should be comfortably warm (90° to 95°), in summer it may be nearly cold; all chilling is to be avoided, and individual idiosyncrasies as to heat and cold carefully respected. When children are ill, and suffering from catarrh, the regular bath may be suspended for a time. Outdoor exercise should be taken every day. Flannel should be worn next the skin; it should reach well up to the neck, and as far down as the knees, in order to

protect without constricting the chest and the abdomen; for sleeping, a 'combination' dress is best; the children cannot then get entirely uncovered, as they are apt to do in the ordinary night-dress. The severer lung and intestinal complications must be treated on the principles laid down in the medical text-books; but it is well to say that cod-liver oil often acts like a charm, even in this stage of rickets.

Deformities, unless very marked, may be left alone; the crooked bones tend to straighten spontaneously under the influence of general remedies. In the case of severe deformities, light splints may be worn. The writer never uses splints which pass beyond the feet; if children are so splinted that they cannot walk, they shuffle about the ground, and take more harm from this mode of progression, and the dangers incidental to it, than the wearing of such splints compensates for. If the deformities resist treatment, or continue to progress notwithstanding, and become really severe, then osteotomy may be resorted to. But patience is the great requisite, as time and cod-liver oil are the remedies for such cases. When cod-liver oil causes diarrhoea, a minim or more of tincture of opium may be combined with each dose until the oil is tolerated. In warm weather, also, the opium sometimes proves a valuable adjunct, and permits the administration of the oil to be continued, when otherwise it could not be borne. *See* BOW-LEG; GENU VALGUM; OSTEOTOMY.

ACUTE RICKETS.—This term has been used by different authors in rather different senses. By some (Jenner, Ritter, Rehn) it has been used to denote an unusually rapid onset of the ordinary form of rickets; by others (Stiebel, Mauthner, Senator) to signify a very severe form of the disease with an acute onset. By Möller it is used to describe what he regards as a disease distinct from rickets, in which subperiosteal hæmorrhages or effusions are a characteristic symptom; by Bohn as an inflammation of bone in consequence of its over-rapid formation; while Henoch hardly believes in the existence of such a condition, chiefly because he has never seen a case in his own practice.

There is no doubt that rickets—like many other diseases—may have a very rapid onset, and occasionally, also, assume a very severe form, for which cases the term 'acute rickets' is very appropriate. Dr. Mauthner of Vienna, about thirty years ago, recorded some of the first and best cases. Dr. Möller of Königsberg also reported three

cases of 'acute rickets' in artificially-fed children, with enlargement of the joint-ends of several bones, occurring simultaneously or in rapid succession; and accompanied with such considerable persistent pain (which was aggravated by handling the children) that osteitis was suspected. There were no bendings in the bones, but in two subsequent cases, he found, *post mortem*, subperiosteal effusions of blood, with spongy (scurvy) gums and sugillations in one of the cases. Later again, Dr. Rehn of Frankfort described a series of cases of 'infantile osteomalacia,' which evidently belong to the same class as the foregoing. Dr. Thomas Barlow regards the term 'acute rickets' as inappropriate, and suggests that these cases are 'probably a combination of scurvy and rickets, the scurvy being an essential, and the rickets a variable element.'

The clinical history of these cases differs widely. The disease is not confined to the poor: it may occur up to three years of age, but is most common under or at about eighteen months; one of the earlier symptoms is pain, which is aggravated when the child is handled. Most of the cases have been in ill-cared-for, artificially-fed children of either sex, and without regard to season. The writer recently saw a well-cared-for infant with this condition highly marked, which had supervened in the middle of summer at Brighton. The duration rarely exceeds two or three months. In some, treatment has appeared of little avail, in others a cure has been effected in a week or two; while other cases have gradually, and for the most part slowly, recovered spontaneously. The general cachexia has not been at all profound, and, when death has occurred, it has been due chiefly to pulmonary catarrh, and not to the local lesions. In a few of the cases the gums are reported to have been spongy as in scurvy, and in some of the cases subperiosteal hæmorrhage has been found. The bones undergo strange deformities, quite unlike those of ordinary rickets; instead of being curved, they assume sharp angular flexions, termed 'inflections,' the epiphysial changes being usually ill-marked. The writer has examined three such cases *post mortem*, and feels no doubt as to the rickety nature of the lesion. Apart from the pathological appearances, there are the social surroundings which usually obtain in the more common form of rickets; the variation from the ordinary type is easily explained by the personal element present in all kinds of disease, and by the age of the patients when attacked. As regards the subperi-

osteal hæmorrhage, it is probably traumatic, and brought about by the rough handling to which many of the children are subjected before coming under treatment.

The appearance of the hæmorrhage early in the course of the disease, the absence of profound cachexia and of putrescence, and of stomatitis in many of the cases, distinguish this lesion from true scurvy. The latter disease, when it occurs in children, presents the same features as in adults, and it is brought about by the same causes—long privation of fresh, and the ingestion of improper, food *during cold damp weather*. It is quite exceptional for adults exposed to these conditions to escape scurvy; on the other hand, the cases of so-called 'infantile scurvy' are extremely uncommon, notwithstanding that an immense number of infants are being brought up on what Mr. Herbert Page describes as 'scurvy diet.'

Treatment.—The affected bones must be carefully protected from injury by appropriate splints; the less the limbs are handled the better. A child should be kept in the prone position, and be moved as little as possible. Place the child on a large soft pillow; instead of the usual dress, cover it with soft warm flannel, and in this way dressing and undressing will be avoided. Opiates may be given to relieve pain, if acute. General treatment must be on the lines already laid down—fresh food and fresh fruits being of great value.

FŒTAL RICKETS.—This term is now reserved for a peculiar form of disease in foetuses, which consists in profound changes in the skeleton having a superficial resemblance to rickets, but which are frequently associated with absence of the thyroid gland, or with premature synostosis of the basi-occipital and basi-sphenoid, or sometimes with both. This condition is also and more appropriately called 'fœtal cretinism;' the severer forms of the disease appear to be incompatible with life, for the cases described have been still-born foetuses of varying ages. A few isolated cases had been previously recorded, but Virchow was the first to describe the condition at all accurately. Many cases have since been reported. The extreme shortness of the diaphyses, relatively to the large size of the epiphyses, is the most marked pathological feature; microscopically examined, there is very deficient ossification at the epiphysial line, with intrusion of fibrous tissue from the periosteum, which Mr. Bowlby regards as the cause of the shortening and of the changes in the cartilage. The premature synostosis at

the base of the cranium has been found in several cases; but it is not invariable. Virchow regarded this as the distinct feature of this condition, and the cause probably of the arrested brain-growth. As for the thyroid gland, it has been found absent in some cases and present in others; the part which its absence or presence plays in the causation of this form of cretinism cannot therefore be estimated. A goitre has been found in some cases, and in a few others peculiar masses of fat above the clavicles are met with. Children with the less severe forms of the disease not only survive their birth, but may live for many years. Not infrequently one of the earliest signs of their cretinoid condition is hypertrophy of the tongue, which projects beyond the lips. Then the child gradually assumes the look of hebetude which is characteristic of the disease; intellectual and bodily development are greatly impeded, so that they still appear young children even at sixteen or eighteen years of age.

Authorities agree in regarding this condition as entirely distinct from ordinary rickets. It would be well, therefore, to discontinue the term 'foetal rickets' and substitute 'foetal cretinism.' Dr. Barlow points out how the disease attacks the cartilage bones only, the bones which are formed in membrane being all well developed. The enlargement of the *whole* epiphysis; the thickening of the shafts of the long bones, which are hard and compact; and the absence of rarefaction in the medullary part of the bones distinguish the condition from true rickets.

LATE RICKETS.—Cases of rickets commencing at eight, nine, or ten years of age are by no means rare, though exceptional. Glisson refers to a case of rickets in a man twenty years of age. In the Middlesex Hospital Museum are casts of rickety deformities of the legs in a young man aged twenty, which appeared after an operation for genu valgum. The writer has seen two cases of typical rickety deformity in subjects fourteen and sixteen years of age, which were said to have 'come on quite lately.' Besides these, several anomalous cases of bone-disease in young adults have recently been put on record, in which the epiphyses have shown rickety enlargement, while the shafts have presented other changes less easy to define. By some, the condition is regarded as a juvenile osteomalacia, and an attempt has been made to trace a connection between this latter disease and rickets; the differences between extreme cases are quite obvious, while intermediate ones—that is to

say, cases of late rickets and of early osteomalacia—are said to merge one into the other.

The writer is not at all inclined to acquiesce in this view. It is obviously unscientific to argue, because the ultimate outcome of two processes is more or less alike, that, therefore, they are identical. Pathological processes must rather be interpreted in the light of the clinical history. The rickets of infancy and childhood is a general and not a local disease, and death never takes place in consequence of the local bone-manifestations. Osteomalacia, on the other hand, is a disease of adult life, and of bones which were once absolutely healthy. The disease, unlike rickets, is local in its commencement, and remains so for years in some cases, while steadily progressing nevertheless; all the other functions of the body go on unhindered. Women, whom the disease chiefly affects, bear children; their intellectual power is unabated, and all the other functions may go on normally. Osteomalacia is a degeneration, a softening of healthy bones; rickets is an arrested and deficient development, not of the bones only, but a condition in which all the tissues participate. In a few exceptional cases, rickets may come on later in life than usual, just as osteomalacia may occur a little earlier. Rickets, however, is a very uniform disease, especially as it affects the bones, and the resulting deformities resemble each other as closely as the manifestations of the most specific diseases; the same may be said of the osteomalacia of women. The intermediate cases, which differ immensely among themselves, must, for the present, be relegated to a separate category. The causes which lead to this condition are not known. There can, however, be little doubt that late rickets is the expression of debilitating influences, of one kind or another, acting on the organism at large.

RELAPSING RICKETS.—A term applied to those cases in which the disease, having been apparently arrested for a year or two, again becomes active. Such cases are by no means uncommon when looked for. In the writer's opinion many cases of 'late rickets' may be accounted for on this supposition. Intervals of a year or eighteen months or even longer occur, during which no further signs of rickets manifest themselves. Then, owing either to want of care, to untoward surroundings of various kinds, to acute illness, or to change of air from a dry open country to a cold, moist, overcrowded town, sometimes without appreci-

able cause, a child's health gives way, and rickety (generally bone) disorder again shows itself. The symptoms vary with the age of the patients, and with their early bringing up. Knock-knees and other deformities arising from loose ligaments, such as spinal curvature and flat-foot, generally belong to this category. The treatment of these conditions must be conducted on the principles already laid down.

ROBERT WILLIAM PARKER.

RIDER'S BONE or RIDER'S STRAIN.—In persons who ride much, a hard lump sometimes forms on the inner side of the thigh, near the pubes. It is due to an ossification of the tendon of the adductor longus or gracilis, or to an exostosis growing from the pubes, and extending along the adductor tendon. There is a history of a severe strain, which has ruptured some muscular or tendinous fibres, or torn the tendon partially from its insertion. The subsequent irritation of the saddle causes the growth of bone. No treatment is of any avail, but this does not matter much, seeing that the swelling is more troublesome from its size and situation than from any pain it causes, and is very rarely seen in this country.

A. G. MILLER.

RIGOR is the name given to an aggregation of phenomena, all referable to the central nervous system, which, while frequently heralding the appearance of more unequivocal signs of serious mischief, are not necessarily developed in proportion to the gravity of the illness.

Symptomatology.—A patient, the subject of a severe rigor, lies shaking from head to foot, with tremors (frequently amounting to violent clonic spasms) affecting every muscle; consequently, the teeth chatter, the face twitches, the eyelids and corners of the mouth making opening and shutting movements; the head, supported on each side by the pillow, rarely moves much, the body often rolls in the bed, from the jerking impulses given to it by the violent contractions of the muscles which pass from the trunk to the limb-bones. Indeed, the bed is very frequently shaken by the violence of the tremor.

All this time, although the temperature is rising and may be up to 104° F., the patient complains very much of feeling intensely cold, and covers himself with every possible wrap, or gets close to the fire. There are no symptoms to indicate any active change occurring in the highest

nerve-centres, for the patient is always perfectly conscious, and sometimes his special senses appear to be rendered more acute. The clonic spasms, though varying considerably in force, exhibit a fairly constant rhythm, the rate of which appears to be frequently the same as that of ankle clonus, but sometimes of only half that rate.

In addition to the above-mentioned motor symptoms, others are often seen which indicate disturbance of centres for functions besides movement. Thus, vasomotor changes are observable in the shape of a leaden colour of the skin, which is dry and rough. Other centres in the medulla oblongata are also disturbed, so that the patient may be nauseated or actually vomit, the respirations may be slowed, and the action of the heart enfeebled and quickened. As indicated above, the temperature is usually rising at the time when the rigor occurs, for a rigor customarily occurs when the temperature has gained from one-half to two-thirds its maximum height.

Etiology and Causation.—There is no striking peculiarity about the array of symptoms, familiarly termed a rigor, which furnishes us with the slightest clue to its causation in fully ninety per cent. of all cases; for while we know so little respecting the origin and causation of acute specific fevers, it is clear we shall remain ignorant of that pathological state of the central nervous system which produces the rigor heralding the onset of the disease.

There only remains to us the suggestive fact of rigors being sometimes produced by traumatic influences. It is well known that, after sudden dilatation of the urethra by a catheter, there frequently follows a violent rigor, accompanied by a rise of temperature. *See URETHRAL FEVER.* In such a case, we have simply the irritation of peripheral nerves causing a profound disturbance of the spinal cord and medulla oblongata. Of the accuracy of this pathology there can be very little doubt, but it would be very improper to apply it to explain the occurrence of rigors in pyæmia, ague, &c., until the causes of those diseases are thoroughly known. That rigors are of central origin is obvious, and the only question is the mode of irritation which the nerve-centres suffer.

Treatment.—The treatment of a rigor has almost always been the simple plan of stimulation and heat, in the shape of doses of brandy and hot water, extra blankets, and hot bottles. If it were not for the

concomitant disturbance of the heart, &c., rigors would require but little attention. It has been shown, experimentally, that any drug which narcotises the nerve-centres exerts thereby a powerful preventive effect on rigors and pyrexia. Thus, Dr. Johnson proved that chloroform, &c., would arrest a rigor, and it is well known that morphia and quinine will prevent and arrest rigors due to catheterism, and possibly those occurring in pyæmia. But, for practical purposes, it will be found best to administer a hypodermic injection of morphia (gr. $\frac{1}{4}$ to gr. $\frac{1}{3}$), to cover the patient with blankets, to warm the surface of the body with heated air or hot-water bottles, and to supply him freely with hot alcoholic drinks. For the *prevention* of rigors, see URETHRAL FEVER.

Prognosis.—As far as the rigor itself is concerned the prognosis is always very favourable, however alarmingly violent the spasms may be; but, as indicating other mischief, the occurrence of a rigor will always render the prognosis very serious, and, if there is concurrently suppression of urine, &c., it will make it practically hopeless.

VICTOR HORSLEY.

RINGWORM. See TINEA TONSURANS.

RISUS SARDONICUS. See TETANUS.

RODENT ULCER. See CARCINOMA; ULCERS.

ROUGE'S OPERATION may be required for the removal of necrosed or carious bone when, either from the size of the sequestrum or from the situation of the disease, this cannot be effected through the nostrils. It may also be resorted to for removing certain forms of nasal and naso-pharyngeal polypi, when more room is required than can be obtained through the natural passages, and when it is especially desired that no external scar should remain. Further,

it is sometimes useful for allowing the introduction of the finger into the nasal chambers, for the purpose of thoroughly exploring these parts in cases of long-standing disease attended with fœtor, where the presence of diseased bone is suspected but cannot be detected by the mirror or probe.

The operation is performed as follows:—The upper lip having been seized on each side near the corner of the mouth and turned upwards, an incision should be made, reaching from the first pre-molar tooth on one side to that on the other, through the mucous membrane at its reflection from the lips to the gums. The tissues intervening between the mouth and the nasal cavities should next be rapidly divided, and the cartilaginous septum detached with the bistoury from its insertion into the anterior nasal spine. This is often sufficient to allow of the introduction of the finger and the exploration of the nasal cavities; but if more space is required, the lateral cartilages should be detached from the maxillary bones with the scissors, when the nose, thus completely freed, can, especially when the septum has been partially destroyed by the disease, be turned upwards towards the forehead, widely exposing the orifice of the nasal chambers. Where the septum is intact, it will generally require further separation from the maxillary crest by the scissors. The removal of the dead bone or growth, or the exploration of the nasal cavities, having been effected, the lip and nose should be accurately replaced, care being taken that the base of the septum is placed in exact contact with, and is supported by, the nasal spine. No sutures are necessary; little or no swelling of the lip follows the operation; there is, as a rule, no constitutional disturbance, and the parts are usually soundly healed in a few days. W. J. WALSHAM.

RUPIA. See SYPHILIS.

S

SABRE and BAYONET WOUNDS.

Sabre wounds chiefly affect the head and upper extremities, bayonet wounds are chiefly on the lower extremities. Neither are very fatal, the bayonet wound being rather more so than the sabre.

Sabre wounds.—The sharper the weapon, the more the injury inflicted will resemble an incised wound. When the sabre is very sharp it may cut a portion of

tissue completely away. The blunter it is the more irregular and contused the wound will be, and the deeper the weapon penetrates the more it will gape. When the cutting edge strikes the surface perpendicularly, a straight gaping wound will be inflicted; if obliquely, one margin may be concave, the other convex, or the wound may be more or less flap-shaped, especially on the face and skull. When the

bone is implicated by a blunt weapon, it may be bruised or fractured; if sharp, it will be incised or a portion more or less completely detached. The bleeding is not great unless a considerable vessel be injured or the weapon very sharp. If the large veins in the neck are wounded, sudden death may take place from entrance of air. The amount of pain will depend on the nervous supply to the injured part. When large nerve-trunks are divided, there will be interference with sensation and movement in the parts which they supply.

A blow of a blunt sabre on the head will often produce injury of the brain-convolutions of the opposite side, or fracture the skull; especially will the internal table be injured and extensive fissuring produced. The skull and face are most often wounded; next to these the hands and arms almost as frequently. These wounds are much rarer on the chest and back, and very infrequent in the abdomen and lower extremities.

Punctured wounds are caused in time of war by bayonet, lance, and sabre. They are by no means of frequent occurrence, and as seen in the hospitals are not of great severity. There is no accurate information as to the number which prove fatal on the field. They are chiefly met with in the breast, abdomen, and upper extremities; less frequently on the head, face, and lower extremities. They are usually long blind canals with a triangular or quadrangular wound in the skin, according to the form of weapon. The bone may be perforated or fractured. They often contain foreign bodies or a portion of the weapon which has broken off. The vessels often escape in a remarkable manner, and a comparatively small wound in the vessel may sometimes close after the primary hæmorrhage has ceased, frequently to be followed by a traumatic aneurism. When the wound implicates both the large artery and vein, aneurismal varix may follow; nerves may be punctured or divided, and tetanus is then comparatively common. These wounds often penetrate cavities and injure the contained viscera. Cut and thrust wounds may heal by first intention without suppuration, or their progress may be modified by all the circumstances which influence the course of gunshot injuries.

The prognosis will depend on the depth and extent to which they implicate important cavities or organs.

The treatment consists in the arrest of hæmorrhage, the extraction of foreign bodies, and antiseptic purification.

WILLIAM MACCORMAC.

SACRO-ILIAC JOINT, Disease of the.—This joint is not often the seat of primary disease, but is more usually affected secondarily by the spreading of caries from the adjacent surface of the ilium or sacrum. The disease is generally of constitutional origin, and is for this reason, as well as because of its anatomical relation to the spine and pelvis, to be looked upon as an affection of much gravity. It may, however, originate in injury, and occasionally follows parturition.

The earliest *symptoms* of sacro-iliac disease are usually pain and slight lameness. The pain may be felt in the situation of the joint, or in the course of some of the neighbouring nerves. Most often it is felt along the great sciatic nerve and its branches, so that, in the early stage, sacro-iliac disease is apt to be mistaken for sciatica. Not uncommonly also the pain is referred, as in hip-disease, to the hip and knee, in consequence of irritation of the obturator nerve. The pain, wherever it may be, is increased by movement, and whenever the weight of the body is transmitted through the pelvis, as in sitting or standing; so also, an attempt to lift a heavy weight from the ground will generally elicit or aggravate pain. On the other hand, relief is given by the recumbent posture. The lameness at first is chiefly due to slight involuntary elevation of the pelvis on the affected side. Sometimes there is flexion of the thigh, in consequence of irritation of the psoas muscle. As the disease progresses, tenderness will be felt on pressure over the joint; pain will be produced by pressing together the two iliac bones; the gluteal muscles will become wasted; and suppuration will occur. When matter forms, it will most commonly present over the back of the joint, but it may also make its way to the groin after the manner of a psoas abscess, or outwards along the crest of the ilium, or forwards towards the rectum, from which it may be felt by the finger.

Diagnosis.—It will be observed that, in many respects, the symptoms described closely resemble those of disease of the spine or hip, and in the commencement of sacro-iliac disease a careful examination is needful to distinguish it from those affections. From disease of the spine, it will differ chiefly in that the symptoms are referable to one side only of the body; and that if the pelvis is fixed, flexion of the vertebral column is not restricted or painful. From hip-disease, it may be distinguished by the free mobility of the femur independently of the pelvis.

Pathology.—The disease usually begins either in the bone or periosteum, though possibly, in some instances, the starting-point is an extravasation of blood into the tissue about the joint, the result of direct injury. In advanced cases the articular surface is found carious, the fibro-cartilage loose, the ligaments softened, and the joint surrounded by extensive suppuration.

The *prognosis* will depend chiefly on whether the disease is of constitutional or local origin, and upon the extent to which the mischief has progressed before treatment is commenced. In the scrofulous or phthisical the affection is always a grave one, as it must also be considered whenever suppuration has occurred.

In the *treatment*, the first essential is absolute and prolonged rest in the recumbent position. The immobility of the joint may be aided, moreover, by surrounding the pelvis with a well-moulded leather splint or a padded pelvic girdle. The only local application of any use, is the light and repeated application of the actual cautery over the back of the joint. This is, of course, only serviceable during the early stage of the disease and before suppuration has been reached; but at this period it sometimes gives remarkable relief to the pain, especially to that along the course of the sciatic nerve. Blisters and other milder counter-irritants have no effect but that of adding to the discomfort of the patient.

When abscess has formed it is generally best to open and drain it, with antiseptic precautions. If not opened, abscesses are prone to attain a large size, and to burrow in a manner which makes it subsequently very difficult to drain them efficiently; if aspirated they usually rapidly refill. No doubt cases have occurred in which such abscesses have undergone so-called absorption—that is to say, they have dried up; but this implies a residuum of caseous material which may be the source of future dangers. In phthisical cases it is, perhaps, best not to interfere with the abscess unless it is distressing the patient.

When the disease becomes arrested, and only a sinus remains, it may be useful to explore the part to ascertain if there be any removable dead bone, or for the purpose of scraping away the granulations which supply the pus; but these measures should not be resorted to till every opportunity has been given for natural repair. Besides the local measures which have been indicated, the constitutional condition of the patient should receive attention. As a long period of recumbency will be necessary, it

is important to secure the best possible environment; while, at the same time, nutrition should be aided by good food, cod-liver oil, or other suitable tonics.

J. WARRINGTON HAWARD.

SACRUM, Fracture of the. *See* PELVIS, Injuries of the.

SALIVARY CALCULI are concretions of earthy salts deposited by the saliva, and consist of phosphate and carbonate of lime, with a little magnesia, chloride of sodium, and some organic matter. They are usually of elongated form and small size, but may attain very large dimensions; thus, Albert has seen one removed from Wharton's duct which measured over an inch and a half in length, and was as thick as the little finger; and he mentions another as large as a hen's egg, taken from the duct of the parotid. They are most frequently met with in connection with the duct of the sub-maxillary gland, but the ducts of Stenson, Rivini, and Bartholin may also be involved. The obstruction of the tube is rarely complete.

They may appear at any age, and are said to be more common in men than in women. Their development is seldom explicable, but in a few cases the nucleus of the stone has been found to consist of a grass seed or some other foreign substance.

The *symptoms* are usually slight. The patient complains of a sense of discomfort and tension in the situation of the impacted calculus. The gland, from retention of secretion, undergoes painless swelling, which continues until the imprisoned fluid forces a way past the foreign body; the engorgement then rapidly subsides, to be followed by a new accumulation, and a characteristic alternation of tumefaction and collapse becomes established. Cystic dilatation of the tube behind the obstruction is very rare.

The *diagnosis* is effected by careful palpation along the course of the ducts, aided, if necessary, by the introduction of a fine metallic probe.

The calculus may be removed through an incision made into the distended portion of the duct, or the tube may be laid open from its orifice as far as the obstruction. The continuous flow of saliva prevents any tendency to stricture after the operation.

WILLIAM ANDERSON.

SALIVARY FISTULA.—A sinus opening upon the outer surface of the cheek, and communicating with the duct of the parotid gland.

Such sinuses have origin either in wounds of the duct, or in abscess which has burst externally, or in obstruction of the buccal end of the duct, causing its distension and subsequent opening on to the surface of the cheek. Much discomfort is produced by the escape of the saliva upon the cheek; the flow of the secretion being of course increased during mastication.

Treatment.—Fistulæ of recent formation may sometimes be made to heal, if the buccal orifice of the duct be quite free, by covering the opening on the cheek with collodion, a layer of which must be reapplied from time to time, so as to prevent the escape of any saliva; fluid food only being taken during the treatment.

If this does not suffice, the edges of the opening should be pared, and then transfixed with a fine needle, over which a figure-of-eight ligature is to be tied, so as to bring them into accurate apposition. The needle is withdrawn at the end of forty-eight hours, and the wound covered with collodion. Or the orifice of the sinus may be first cauterised with a hot needle and then similarly covered. If the buccal opening is contracted or closed, this must be reopened by passing a fine probe through it; or, if it cannot be found, a probe must be passed along the duct and into the mouth as nearly as possible to the natural orifice (near the second upper molar tooth). Then the duct must be kept open by passing a flexible probe or bougie along it from the mouth, past the fistula, and as far as the gland. This is retained by curving the end which projects from the mouth round the angle of the cheek, and fastening it there by plaster. The fistulous opening is kept covered with collodion, and mastication avoided. J. WARRINGTON HAWARD.

SALIVATION. See *Mercurial Stomatitis* under STOMATITIS.

SALTER'S SWING CRADLES. See CRADLES.

SANDBAGS are useful for steadying broken limbs, either alone or with splints; and in combination with a drawsheet laid over the chest and abdomen and under the sandbag which is placed along each side of the patient, they efficiently overcome the aching of the spine which occurs in the extension treatment of hip-joint disease. The bags should be made of some fine-textured material, such as bed-ticking, and should be only about two-thirds filled with sand, which must be as fine as possible and thoroughly dried.

SAPRÆMIA is a term which may, perhaps, etymologically include more than it is now generally understood to mean; but, expressing as it does very succinctly the condition in which there is present, circulating in the blood of a patient, one of the alkaloidal products of decomposition (*see* SEPSIN), a condition which is otherwise known as septic intoxication—a cumbersome title—or as septic poisoning, which is much too vague, it at least has the merit of brevity coupled with sufficient accuracy to commend it for permanent adoption. By the term *sapræmia* we understand the condition which is sometimes very wrongly called traumatic fever, or, what is worse, simple traumatic fever. The *sapræmic* fever is one, therefore, which is evoked by the entrance of a chemical substance into the bloodstream, and, as a necessary consequence, it disappears directly all possible source of absorption of ptomaines is removed.

But in thus entering the threshold of the subject of SEPTIC DISEASE we must first take note of another pathological (febrile) condition, which is possibly sometimes confounded with *sapræmia*. We refer to poisoning by the so-called blood-ferment. It has now for some years been recognised that the direct agent in the production of fever is usually a derivative (a non-organised substance) of animal tissues. Volkmann and Genzmer, following the line of thought already pioneered by Billroth and Weber, came to the conclusion that the cause of the pyrexia, in cases which had been operated on strictly antiseptically, was a hypothetical substance, 'pyrogen,' which was a derivative of the damaged portions of the tissues operated upon. The researches of Bergmann's pupils—notably Angerer, Edelberg, Köhler, and others—have vividly illuminated this obscure point by their experiments with blood-ferment and the various constituents of the blood. We will here preface their conclusions by recalling to mind the conditions under which ferment-poisoning most probably arises. In cases where considerable venous oozing has occurred, the wound-cavity is full of black clot or black treacly serous discharge, this bloody débris being frightfully septic if the antiseptic precautions have failed; but, if these are successful, of course it is perfectly aseptic according to the tests at present at our disposal, so that that complication does not exist. Further, it is a necessary condition that the drainage of the wound should have been insufficient, and consequently a positive pressure set up in the interior of the wound, so as to mechanically aid the

absorption of its fluid contents. Both conditions are not infrequently produced by the removal of large tumours, &c., from the fossæ of the body.

The most noteworthy contents of the wound, then, are—(1) partly clotted blood, (2) serum (simple), (3) serous exudation, (4) blood-pigments (hæmoglobin, &c.), (5) blood-ferment (Schmidt). Besides these well-known substances there are, no doubt, others to which perhaps some of the effects to be noted presently are due; among these substances the body recently separated by Wooldridge is particularly to be noted.

All the foregoing components of such wound-discharge are pyrogenous; injected into the blood-stream of a healthy animal, each of them excites more or less pyrexia. The injection of a solution of blood-ferment produces symptoms exactly similar to those which follow the injection of sepsin, for there soon ensue tremors, vomiting, cramps, and bloody diarrhœa, while the temperature rises to over 105°.

Enough has been said to show that in 'ferment-poisoning,' as at present understood, we have a severe pyrexial condition, due to the action of the ferment on the central nervous system (any ferment will do the same thing—viz. pepsin, trypsin, &c.), and that, recognising the possible occurrence of this condition, it must always be eliminated in framing a diagnosis in a supposed case of sapræmia.

The etiology of sapræmia is at first sight simple enough—viz. the setting up of ordinary decomposition in a wound which is imperfectly drained; but, in reality, there are more complex conditions attendant upon the course of the putrefaction. These external conditions determine the form of sepsin produced, and hence indirectly the symptoms. Thus, quite recently, Schmiedeberg and a pupil have found that the original ptomaine, called sepsin, is only to be obtained under certain definite atmospheric and other conditions. The same fact is well known to mycologists to influence the evolution of Davaine's septiciæmia.

Similarly, the duration of the 'incubation period,' or rather 'latent period,' which elapses before the first symptoms of poisoning appear, varies directly with the dose, so that no general rule can be laid down on this point.

Next, we must consider briefly the mode of entrance and exit of the poison. As a rule, the poison is absorbed from the cavity of a foul wound by the veins and lym-

phatics, and it may easily be observed, clinically, that the absorption is largely influenced by the (mechanical) tension of the decomposed discharges in the wound. When, however, there is a septic inflammatory process about the mouth or pharynx, as in cancrum oris, &c., then the patient swallows quantities of putrid stuff; and in that case, of course, the absorption is *per* the lymphatics of the intestine and stomach. Finally, where the nose has been the seat of primary putrid inflammation, sapræmia has followed the inhalation of the poison, and the same thing has been observed in the lower animals.

As described in the articles on SEPSIN and SEPTIC DISEASES, the poison is mainly excreted by the kidneys.

Symptomatology.—Just as in the lower animal the subject of experiment, so in the human being, the most prominent symptoms are those produced by disturbance of the nervous system. The first effect of absorption of a ptomaine or sepsin-like substance is headache (frequently very severe); this is followed by nausea and vomiting. A slight rigor may announce the commencement of the rise of temperature, which usually reaches 101°–103° F., and very rarely 104°; the pyrexia is a continued fever until the wound is thoroughly washed out with disinfectant lotion and completely drained, when it disappears at once. (This immediate effect proves that the sapræmic state is due to the absorption of a simple chemical substance, and is in no sense of the word an infective condition.)

Marked changes occur simultaneously in the blood; the patient becomes anæmic, for the red blood-corpuscles vary directly with the amount of poison circulating. There is some leucocytosis also, but the greatest effect is on the number of red discs.

At the same time the excretory organs, which are occupied in getting rid of the poison, are notably affected. The skin is cold and clammy, the urine scanty and concentrated, and sometimes there is diarrhœa, which more rarely is bloody. Diarrhœa, in fact, is next in importance as a leading symptom to those evoked from the nervous system. In final stages, if not previously relieved, the patient becomes delirious, and then the delirium passes into fatal coma. The symptoms will differ according to the difference in the kind of decomposition set up, since the resulting ptomaine poison will be different. *See SEPSIN.*

Pathological Anatomy.—There is little to be found in the post-mortem appearances

of such a case. The most obvious changes are usually found in the alimentary canal, in the shape of violent gastro-intestinal inflammation, the mucous membrane being intensely congested, small extravasations of blood occurring here and there, and Peyer's patches especially swollen and reddened. Similar small extravasations of blood or petechiæ are found beneath the serous membranes. The central nervous system exhibits marked congestion also of the meninges, and occasional hæmorrhagic petechiæ.

The glandular organs, the liver and kidneys, but especially the latter, show well-marked bloody swelling, while the spleen is frequently (but not invariably) swollen. As has been observed in other septic diseases, the corpse of a person who has died of sapræmia becomes putrid very rapidly.

Treatment.—Fortunately, the treatment of this variety of septic disease is easy and almost always very successful, since it simply consists in the thorough cleansing of all putrid stuff from any of the cavities (especially mucous ones) of the body. All wound-cavities, &c., must be freely drained by fresh incision, large tubes being inserted as a preliminary measure, and are then to be freely syringed out with strong disinfectants—e.g. 1 in 20 carbolic acid, &c. In cases where the sapræmic state follows on the advent of a septic inflammatory process, that must be treated by free incision and washing under anti-septic precautions.

Although the local treatment is the one essential point in successfully combating sapræmia, still, there are other factors in the etiology, &c., of the disease which have to be considered and met. Thus, for instance, there is the secondary anæmia and leucocytosis. This is to be treated with iron and quinine. The former is best given as dialysed iron, *mx. bis die*, and the latter simply dissolved in dilute acid, 15 grains per diem to commence with, and increased as soon as possible. But it will be observed of a series of cases that the symptoms differ to an obvious extent. This is doubtless due to the difference in the kind of ptomaine which may be doing the mischief. *See SEPSIN.* And it may occasionally happen where there are very distinct minor nerve-symptoms—e.g. dilatation of the pupil, dryness of the throat, &c.—that the condition will be best met by administering the vegetable alkaloid which is antagonistic to the one that appears to be imitated by the particular ptomaine under

observation. Thus, if the above-mentioned symptoms were present, it might be of advantage to inject eserine hypodermically. *See HYPODERMIC INJECTION.*

Finally, we would repeat that sapræmia is usually a complication of some infective disease, and that altogether it may be treated apparently successfully in a few days. The chance of the patient's having contracted pyæmia, &c., must be borne in mind. This is notably the case where the sapræmia is of puerperal origin.

Prognosis.—Good, if a simple case.

VICTOR HORSLEY.

SARCOCELE. *See* TESTIS, Diseases of the.

SARCOMA. — *Structure.* — The sarcomata may be defined as tumours of connective-tissue origin, composed of connective-tissue cells. There is often no definite stroma, and, when present, it is—with one rare exception—not arranged in the form of definite alveoli, the cells being uniformly distributed throughout the tumour. The sarcomata are generally largely supplied with blood-vessels, the smallest of which are extremely thin-walled and sometimes appear as channels bounded merely by the cells of the growth. No lymphatics have ever been demonstrated. The cells multiply by fission.

The sarcomata may be conveniently divided into four chief groups—(i.) *round-celled*, (ii.) *spindle-celled*, (iii.) *mixed-celled*, (iv.) *giant-celled* or *myeloid*.

(i.) **ROUND-CELLED SARCOMATA.**—These tumours are composed of round, granular cells of connective-tissue type, frequently multi-nucleated, not generally varying in size in any individual tumour, embedded in a soft, granular, or homogeneous matrix, abundantly supplied with blood-vessels. In some tumours the cells are no larger than leucocytes—small round-celled sarcoma; in others they are more than double or treble this size—large round-celled sarcoma. The cells have no definite cell-wall, and there is often but little protoplasm around the nucleus.

(ii.) **SPINDLE-CELLED SARCOMATA.**—The spindle-celled sarcomata consist of closely packed spindle, oval, fusiform, and oat-shaped cells, generally granular and often multi-nucleated, embedded in a homogeneous matrix. The cells are for the most part arranged with their long axes parallel, but are frequently collected into interlacing bundles. They vary in size in different tumours, but in any individual growth are frequently of

the same diameters throughout. In the small spindle-celled variety their diameter does not exceed that of a leucocyte, and is about one-fourth that of their length, while in the large spindle-celled sarcomas, the cells are sometimes as much as five or six times these dimensions.

(iii.) MIXED-CELLED SARCOMATA.—The mixed-celled sarcomas, as their name implies, are composed of cells of various forms, such as may be met with separately in either of the two previous groups. The cells frequently differ in size as much as in shape.

(iv.) GIANT-CELLED OR MYELOID SARCOMATA.—These sarcomata are composed for the most part of spindle or oval cells, such as have been already described. Mingled with them, however, are a varying number of large, irregularly shaped cells, often twenty to thirty times larger than their neighbours, granular, flattened, and containing from ten to forty or more nuclei.

Varieties.—Although all sarcomata may be classified in one of the above four groups, yet it is convenient to subdivide them into several varieties, each of which differs in some important essential from the others. The following are the chief varieties.

MELANOTIC SARCOMA.—These tumours are distinguished by the presence of granules of black or brown pigment, in varying amount, scattered through the growth in a very irregular manner, and often absent in one part of a section, while, in another portion, the structure is hidden by masses of colouring matter. Most of the melanotic tumours belong to the round-celled variety of the sarcomata, but in some cases the pigment is found in spindle-celled growths. The pigment occurs both in the cells and in the matrix. Melanotic sarcomas are also not infrequently 'alveolar' with respect to their stroma. See *Alveolar Sarcoma*.

LYMPHO-SARCOMA.—The lympho-sarcomata are composed of very small round cells, lying in a slender, fibrillated matrix; the cells are no larger than leucocytes, and a section of such a growth is almost a *facsimile* of the more cellular part of a lymphatic gland.

GLIOMA.—The gliomas resemble closely the lympho-sarcomas. Their matrix is precisely similar to the neuroglia tissue in the nerve-centres, being a loose meshwork with branching cells. The sarcoma cells are of the small round variety. See *RETINA*.

ALVEOLAR SARCOMA.—The cells in alveolar sarcoma are generally round, but

may be oval or spindle in shape. They are contained in separate alveoli, formed by bundles of connective-tissue. The amount and consistency of this latter is very variable; it is generally much less than is present in the carcinomata, and is sometimes represented by a few fibres and long spindle-cells placed side by side. It is, in some cases, difficult to distinguish the sections of these growths from the alveolar carcinomata. It should therefore be noted (1) that the cells are generally smaller and more granular, and do not possess a translucent body, as do typical epithelial cells. (2) That in any alveolar sarcoma there is often a portion of the tumour composed simply of typical sarcoma-tissue without alveolation. (3) That the cells may be separated from each other by delicate filaments of connective tissue.

HÆMORRHAGIC SARCOMA.—These sarcomas belong to the round or spindle-celled groups. Their peculiarity consists in the extreme tenuity of their blood-vessels and the consequent liability to hæmorrhage, for as fast as they grow peripherally their central parts are broken down by extravasation of blood into a soft mass, which soon becomes indistinguishable from altered blood-clot, of which, indeed, it is almost entirely composed.

PLEXIFORM SARCOMA OR CYLINDROMA.—This rare form of tumour is essentially a sarcoma, some of the cells of which have undergone a hyaline degeneration. The unaltered masses of cells thus appear on section to be contained in alveoli, the walls of which are composed of hyaline material. The cells are generally round, but not infrequently polygonal, are closely packed, and not apparently separated by any intercellular substance. In some cases, the hyaline degeneration may be traced as commencing in the walls of the blood-vessels.

PSAMMOMA—PEARL TUMOUR.—This form of sarcoma has hitherto been found only within the cranial cavity, and, usually, in connection with the pineal gland. It is characterised by the presence of concentric calcareous masses, surrounded by fibrous tissue and attached to fibrous trabeculæ.

Degenerative processes in the Sarcomata.—The most common form of degeneration seen in the sarcomata is that known as 'mucoid.' It usually commences in the most central parts of the growth by the distension of the cells with a clear gelatinous fluid, the cells burst, and the mucous fluid is discharged. In some cases the matrix seems to undergo a similar change. The result of

this process is the gradual liquefaction of the tumour and the formation of a cyst. The degeneration frequently commences at several separate foci, so that multiple cysts are formed. Sarcomata may also be the seat of fatty degeneration.

MIXED TUMOURS OF CONNECTIVE-TISSUE TYPE.—The whole of the connective-tissue tumours originate by the proliferation of connective-tissue cells. In any case where the tendency is for these cells simply to *multiply*, a sarcomatous tumour results; and where, in addition, no tendency whatever to *develop* into one of the adult forms of connective tissue is present, the tumour is composed simply of round cells—a round-celled sarcoma. The first evidence of development is seen in the elongation of the cells into spindles or ovals, and the production of a spindle-celled sarcoma. But in many tumours a further tendency to development is present; and, inasmuch as from connective-tissue cells any of the connective tissues may be built, the sarcoma cells become variously mingled with fibrous tissue, cartilage, bone, fat, &c. Supposing that the bulk of the tumour continues cellular, the name sarcoma is still retained, and an adjective, indicating the nature of the developed tissue is prefixed—e.g. fibro-sarcoma, chondro-sarcoma, &c. It is at this point that great difficulty often arises as to whether a growth is, from microscopical examination, to be considered innocent or malignant. For the fibro-sarcomas merge imperceptibly into the sarcomas on the one hand and the fibromas on the other; the chondro-sarcomas into the chondromas; the osteo-sarcomas into the osteomas, and so forth. From a microscopical point of view, it must be laid down that any tumour in which are collected masses of connective-tissue cells must be placed amongst the sarcomata, whilst those in which no such collections are present belong to the innocent class of connective-tissue tumours.

It may be well to describe briefly the general structure of the four most common forms of mixed growth:—

(1) **FIBRO-SARCOMA.**—This form of tumour generally belongs to the spindle-celled group, and was formerly described as ‘recurrent fibroid.’ The spindle cells are often large, and are mixed both with young connective-tissue and with broad bands of fully developed fibrous tissue.

(2) **MYXO-SARCOMA.**—In myxo-sarcoma the stroma of the tumour consists of branching cells enclosing spaces, in which is contained a clear mucous fluid. In these

spaces are also sarcoma cells. These growths gradually fade into the class of soft fibromas and true myxomas, and from these it is often difficult to separate them.

(3) **OSTEO-SARCOMA.**—This form of tumour occurs only in bone. It consists of a varying amount of sarcomatous cells, mingled with and enclosed by bone trabeculae. See TUMOURS OF BONE.

(4) **CHONDRO-SARCOMA.**—The cartilage met with in this form of growth may be either fibrous or hyaline; the sarcoma cells are either round or oval.

The naked-eye appearances of the sarcomata vary indefinitely. In shape, size, and outline no two are alike. On section, the sarcomas that are unmixed with other tissue may be soft, brain-like, and pulpy, readily breaking down on pressure; frequently they possess a gelatinous semi-translucent structure; frequently also they are of a red and fleshy appearance; in any case they may be more or less infiltrated with blood. In one respect they differ, however, from all other tumours—namely, in the homogeneous appearance of their cut section, for, in a typical sarcoma no appearance of fibrillation or of lobulation is to be found. Of course, in proportion as the sarcoma tissue is mingled with fibrous, cartilaginous, or other structures, so the appearance on section will differ. Again, where degenerative changes have been in progress, a variable amount of cystic degeneration, with varying degrees of consistence, will be found.

On section, the sarcomata often appear to be encapsuled, their edges being rounded and apparently well-defined. But although in some few cases they are contained in a pretty definite cyst-wall, in by far the majority of instances the appearance of a capsule is misleading, and, on attempting to separate the new growth from the surrounding tissues, they will be found almost inseparably blended. In other sarcomata, and these the most malignant and rapidly growing, there is no appearance of a capsule, and the tumour infiltrates the surrounding parts in an irregular fashion, being altogether inseparable from the tissues in which it grows.

To the naked eye the *hæmorrhagic sarcomata* often appear simply as hæmatomas, but if careful examination be made, their cyst-wall will almost invariably show evidence of new growth in some part of its circumference. They generally contain both fluid and clotted blood of a dark colour.

The *myeloid tumours* of bone have in part a red-brown or maroon colour (not

unlike that of the normal heart), which when present gives to them a very typical appearance. These growths often possess a pretty definite bony cyst-wall, from which they may easily be shelled out. They are very prone to undergo degenerative changes, so that the hollow formed by the expanded bone is frequently found filled with a broken-down pulp. In some cases, large vessels open into the cyst-like cavities thus formed and produce an evident pulsation, thus forming the so-called 'pulsating tumours of bone.'

The *periosteal sarcomas* of the long bones grow beneath, and strip up the periosteum; they infiltrate both it and the subjacent bone. The most superficial parts of them resemble the sarcomas as already described, but in their deeper portions they are usually completely ossified. They are never encapsuled. See TUMOURS OF BONE.

The *Localities* in which the sarcomata grow are very various. They may develop in almost any part of the body, for connective tissue is to be found in every organ and tissue to a greater or less extent. There are, nevertheless, certain situations in which sarcomata are more common than elsewhere.

The *round-celled* groups are found in the secreting glands—e.g. the testes, parotid, and sometimes the breast. That variety called 'alveolar' occurs chiefly in the skin; the melanotic variety in the skin and in the eyeball; the lympho-sarcomata in the lymphatic glands.

The *spindle-celled* sarcomata occur chiefly in the intermuscular fasciæ and subcutaneous tissues—as periosteal tumours of the long bones, especially of the femur and tibia; also in some of the glands, especially the breast and parotid.

The *mixed-celled* sarcomata are also found chiefly in the connective tissues of the extremities and in the periosteum of the long bones.

The *myeloid tumours* grow inside the long bones, which they tend to expand in their growth; they are found chiefly in the articular ends of the femur, tibia, and humerus. Apart from the long bones, myeloid growths are most commonly met with in the superior and inferior maxillæ.

The *gliomas* are found either in the eyeball or else in the brain and spinal cord.

The *hæmorrhagic sarcomas* occur almost invariably in the connective tissues of the extremities.

Of the various mixed tumours of connective-tissue type the *fibro-sarcomas* are the most common. They occur in the sub-

cutaneous tissues, in the periosteum of the long bones, and in the breast; they are the most usual form of sarcoma met with in the latter organ.

The *chondro-sarcomas* grow more particularly in the articular ends of the long bones, in the parotid, the testis, and very rarely in the breast.

The *osteo-sarcomas* grow in the bones, especially those of the extremities.

The *myxo-sarcomas* are found in the mucous cavities, such as the nose and antrum. They occur also in the uterus and in the parotid glands.

Clinical Characters of the Sarcomata. In speaking of the sarcomata in general, it is impossible to describe with anything like accuracy the special characters which appertain to the various tumours of this class, for they vary immensely according to their locality.

These growths may be said to occur more frequently in the young and middle-aged than in the old, to follow injuries with tolerable frequency, and to grow rapidly. The more malignant the tumour the more rapidly it grows. The amount of pain caused by such a growth necessarily varies greatly; frequently no pain or tenderness is complained of.

When in a situation favourable for examination, a sarcoma presents itself as an irregularly rounded or oval swelling, sometimes a little lobulated, but with a surface generally smooth, adherent to the parts amongst which it lies, and therefore more or less fixed, and firm, elastic, or semifluctuating to the touch. The more rapid the growth of the tumour, the more soft and fluctuating is it as a rule. It is usually very vascular, and attention is called to this by the enlarged and tortuous veins in its neighbourhood.

Of the varieties of the sarcomata the following points may be briefly noted:—

The *melanotic sarcomata* of the skin generally develop in the site of a previously existing mole or wart, sometimes when either of them has been irritated by caustics or by imperfect attempts at removal. Rapid growth in a mole or wart, previously quiescent, should then always be looked upon with great suspicion, and radical treatment never delayed. In the later stages of melanotic sarcoma multiple growths are common, and pigment-granules may be found in the urine.

The *hæmorrhagic sarcomata* are rapidly forming tumours, evidently fluctuating, situated generally on one or other extremity, with no signs of inflammation, and,

when tapped, yielding usually dark-coloured blood. They rapidly refill after tapping, and continue to increase in size—a point to be noticed, for simple hæmatomas do not increase unless they become the seat of suppurative changes.

The *sarcomas of bone* grow almost invariably at the articular ends of the long bones and in the bones of the face. The myeloid growths, commencing within the cancellous tissue, expand the bone in their growth, and so become covered by merely a thin shell which, on pressure, is readily indented, with a crackling sensation. This bony crackling is never present in the subperiosteal sarcomas. Occasionally, also, the central tumours of bone are the seat of distinct pulsation, caused by the opening of large vessels into the cysts formed by degeneration of the tumour-mass.

The *periosteal sarcomas* are more rapid in their growth than the endosteal; they grow on one aspect of the bone, and do not pulsate. Neither the central nor the periosteal growths often cause glandular affection. See TUMOURS OF BONE.

Signs of Degeneration in Sarcomata.—As already described, the sarcomata may undergo degenerative changes, resulting in the formation of cysts containing fluid within the tumour-mass. These collections of fluid necessarily yield a distinct sense of fluctuation, and those parts also which are yet in the process of degeneration, but which, though succulent, are not yet fluid, feel in a corresponding degree softer than the rest of the sarcomatous growth. Thus, in a sarcoma that is degenerating, the whole mass varies in consistency at different points.

Signs of Inflammation in the Sarcomata.—Although, as a rule, the sarcomata grow without any definite signs of inflammation, it must nevertheless be remembered that, very rarely, not only may such tumours show all the local signs of inflammation, but that pus may be formed within the new growth itself, and the abscess may come to the surface and burst, in a manner which differs in no way from that which pertains to simple abscess situated amidst the tissues of the body. So, pain, redness, heat, and swelling are all compatible with the presence of a sarcoma, and, yet further, the temperature may be raised and may continue at 101° or 102° F. for many days, even when there is no suppuration.

Differential Diagnosis of the Sarcomata.—It is not possible in the present article to deal at all fully with the differential diagnosis of the sarcomata; all

that is therefore attempted is to point out the chief only of those swellings which may be mistaken for the sarcomas.

To facilitate this, the writers suggest that the tumours in question should be considered according as they are found—A. In the soft connective tissues. B. In the glands. C. In the bones.

A. *In the soft connective tissues* the sarcomata must be especially distinguished from—1. Cysts. 2. Abscesses. 3. Hæmatomas. 4. Syphilitic swellings. 5. Innocent tumours.

1. *Simple or serous Cysts.*—The locality of the swelling may be such as to make it highly improbable that it is cystic. The growth may have been more rapid than is usual in cysts. If large and superficial, cysts are often translucent—sarcomas never. If tapped with an aspirator or fine trocar, a simple cyst will be entirely emptied and its contained fluid will be found clear and serous. If a solid sarcoma be tapped, only bright blood will escape; if one that is undergoing cystic degeneration, the fluid that is drawn off will be dark and blood-stained, and, when it has ceased to flow, some of the swelling will still remain and can be felt to be solid. Fluctuation is much more marked in a cyst, and is readily transmitted from its extreme boundaries. This is not usual in sarcomas, even in those that are undergoing cystic degeneration.

2. *Abscesses* which are chronic and deeply seated may simulate sarcomas very closely, but some of the signs of inflammation will generally be present, and often there is, if nothing else, a little œdema of the superjacent skin. On the other hand, a sarcoma that is inflamed may closely simulate an abscess. In many cases, tapping alone will clear up the diagnosis.

3. *Hæmatomas*, as already mentioned, may closely simulate or be simulated by the hæmorrhagic sarcomas. The rapidity of growth, the rapid refilling after tapping, and the increase in size, independently of any inflammatory changes, will usually serve to distinguish this variety of sarcoma. For it must be remembered that tapping alone will not decide the question, the dark-coloured bloody fluid answering equally well for the contents of either a hæmorrhagic sarcoma or a hæmatoma, and the size being as much reduced in the one as in the other. The latter swellings, however, do not rapidly increase in size unless they become the seat of suppuration.

4. The diagnosis from *Syphilitic Gummata* is sometimes very difficult, and often at first impossible; for although other evi-

dence of syphilis in the same individual will make the diagnosis of gumma probable, it will not necessarily disprove the sarcomatous nature of the growth. As a rule, a decision will be most readily arrived at by placing the patient under antisyphilitic treatment.

5. *From Innocent Tumours.*—The lipomata and soft fibromata are the innocent tumours which, to the touch, most resemble sarcoma, but it is chiefly when growing in unusual situations or existing under unusual conditions, such as being injured, inflamed, &c., that any difficulty of diagnosis arises. A satisfactory conclusion will generally be arrived at by a careful comparison of the physical characters of the sarcomata with those of the innocent tumours. But the rapidity of the growth is the most essential particular into which inquiry should be made, the increase in size of the malignant tumours being very much more rapid than that of the innocent one.

Nævoid growths also may simulate sarcomata. Their congenital occurrence and great vascularity, combined with the fact that their size may be diminished on pressure, will generally, but not always, serve to distinguish them. In cases of large subcutaneous nævi the diagnosis may be very difficult.

B. *In the Secreting Glands.*—In the breast, parotid, and testis more particularly, the sarcomata have to be diagnosed from—1. Carcinomata. 2. Tumours of an innocent nature. 3. Cysts and abscesses.

1. From the *Carcinomata* the sarcomas may be distinguished, in most cases, by attention to the descriptions already given of the clinical characters of these growths. See CARCINOMA. Diagnosis is not of material importance, for the treatment of each class of tumours is alike. Carcinomas are rare in the parotid, sarcomas common.

2. From *Innocent Tumours* the diagnosis may be made by attention to the rapidity of growth, the infiltration of the tissues, and the affection of the general health, as well as by the physical characters of the growth itself.

Such special swellings as hæmatocele and chronic orchitis are considered elsewhere. A tumour of long duration must not be judged innocent from that fact alone. For, though of slow growth and apparently innocent, it may after some years begin to grow rapidly and exhibit all the signs of malignancy.

3. From *Abscesses and Cysts* the diagnosis may be made in a similar manner to that already described in dealing with sar-

comas of the soft connective-tissues, bearing in mind, in the case of abscesses, any points of special history which may belong to the part of the body affected—e.g. history of recent parturition and lactation in the case of the mammary gland, of urethral inflammation in the case of the testis, &c.

C. *In the Bones.*—In the bones the sarcomas are chiefly simulated by or else simulate—1. Joint-disease. 2. Quiet necrosis without suppuration. 3. Chronic periostitis.

1. From *Joint-disease* the sarcomata may be diagnosed by the healthy condition of the patient, by the rapid increase in size of the swelling, the enlarged and tortuous veins on the surface, by bulging more on one side of the articulation than another, by the frequently painless, though limited, movement of the joint itself, by the evident implication of one bone greatly in excess of the other, by the absence of inflammation and of starting pain at night, and by the failure of all treatment. It must be clearly remembered that the joint may itself become diseased by the encroachment of the tumour. In these cases of sarcoma signs of inflammation are often well-marked, and great care is frequently necessary to establish a diagnosis.

When the tumour grows from the centre of the bone, and more particularly when of the myeloid variety, the presence of 'egg-shell' crackling, and occasionally of pulsation, will show clearly the nature of the swelling.

2 and 3. *Swellings on bones the result of quiet necrosis* or else of *simple or syphilitic chronic periostitis* may be considered together. In many cases no difficulty arises in separating such inflammatory swellings from the sarcomata of bone, but, in those instances in which the inflammatory symptoms are but little marked, the diagnosis may be so difficult that, without incising the swelling, it is not possible to be certain of its nature. It is well to bear in mind, in considering such a case, that the sarcomata almost invariably grow at the epiphysial ends of the bones, so that any tumour situated on the shaft is not likely to be sarcomatous. Moreover, in cases where the swelling is due to periostitis, its shape is suggestive rather of enlargement of the bone, with preservation of the general outline, than of a tumour presenting on one aspect alone; whilst, to the touch, the sarcomatous growth is not hard and incompressible in its whole extent, but in parts is often soft and elastic. Reliance must not be too strongly placed on an increase or

abnormally wide variation of the body temperature, for in the sarcomata of bone such increase and variation may be present, and the temperature chart may be indistinguishable from that of hectic fever. Again, if the swelling be due to chronic periostitis, treatment by counter-irritants and absorbents, especially iodide of potassium will often result in its disappearance; though, if quiet necrosis be at the bottom of the inflammation, this disappearance will not take place. In all doubtful cases an exploratory incision should not be too long delayed. And even after such incision has been made the diagnosis is not always easy, for the thickened and inflamed soft tissues around the dead bone may closely resemble sarcoma.

For *Etiology; Clinical differences between malignant and innocent tumours;* and for *Treatment of the sarcomata*, see MALIGNANT TUMOURS.

W. MORRANT BAKER.
ANTHONY A. BOWLBY.

SAYRE'S SPLINT for the hip consists of a metal bar, which reaches, as an outside thigh-splint, from the pelvis to the knee. This bar is composed of two pieces, one of which slides within the other and is capable of being fixed, as required, by a ratchet. The upper end of this bar is connected, by means of a ball-and-socket joint, to a padded metal band, which is meant to encircle the pelvis; from the lower end of the bar two arches pass off with sufficient span to reach over the front of the thigh to the inner side of it, where they become continuous with a short longitudinal bar. At the lower end of both the outer and inner longitudinal bars there is a pulley, and just above the latter there is a buckle. There is also a perineal band which, when the splint is applied, is buckled in front and behind to the pelvic girdle. To apply the splint, two pieces of strapping, with a piece of webbing stitched to one end of each, should be fixed to the inner and outer surfaces of the thigh by another piece wound spirally round the limb, and by a few turns of bandage placed over all. The pelvic girdle and perineal band should next be adjusted, the metal bar being placed in position along the outer side of the limb; and then the pieces of webbing, above mentioned, should be carried round the pulleys at the lower end of the splint, and fastened up tightly to the buckles. By turning a key the splint can be lengthened, and as the thigh is fixed by the strapping to the lower end of the splint, and as the perineal band

will check upward displacement of the pelvic girdle, the lengthening of the splint will cause extension at the hip-joint. See HIP-DISEASE. BILTON POLLARD.

SCABIES, or the ITCH.—*Definition.*—

A contagious disease of the skin, due to the presence of a small mite known as the *Acarus scabiei*. See *Acarus Scabiei*, under ACARUS.

Course and Symptoms.—The female acarus penetrates and burrows into the substance of the epidermis, and oftentimes into the hair-follicles. In this burrow or cuniculus, which in the early stages is not well-marked, and in cleanly people is difficult of detection, the female, being unable to retreat by reason of certain projections or spines with which its body is armed, lives, lays eggs, and dies; the male, on the other hand, lives on the surface of the skin, some say in the shallower burrows. The lesions produced depend upon the depth of penetration of the acarus and the susceptibility of the individual attacked. The earliest signs are the formation of minute inflammatory macules, papules, and vesicles. The sympathetic irritation is very considerable, extending to parts far removed from the seat of the acarus or acari. If neglected, the disease spreads daily, until at the end of three or four weeks all the characteristic parts have become affected. The position of the burrow is beneath the horny layer of the epidermis and in the upper part of the rete. The burrow is slightly raised and very tortuous, and its average length is one-fifth of an inch, but occasionally it reaches the length of two or even three inches. In appearance it is of a whitish or yellow colour, and, seen through a glass, is either dotted from ova and excreta or black from dirt. A vesicle is often formed at the point of entrance to the burrow, at the other end of which will be found the acarus. As a rule, burrows are only to be discovered between the fingers and toes, on the wrists, and on the navel and penis; and even on these parts they may be completely destroyed by scratching, or obscured by much pustular eruption and scabs. To remove an acarus, it is necessary to place a needle flat upon the surface of the skin—and not perpendicularly—the point is then inserted into the burrow at right angles to its course, and on slowly moving it away from the vesicular end, the acarus, if alive, will adhere to the needle.

The eruption, which is of an eczematous character, is always accompanied by much

itching at night, produced by the warmth of the bedclothes. Papules, vesicles, and pustules may all be present at the same time. The papules are usually numerous, always small, and, according to Dr. Liveing, generally more isolated and scattered than those of simple eczema, and do not early develop into large excoriated patches. The vesicles are of various shapes and sizes, usually have inflamed bases, and often show parts of burrows on their summits, in which condition they may remain or, passing into pustules, increase to a considerable size and extend. The disease usually begins on the hands, especially between the fingers, whence it is commonly communicated to the penis in urination. In women, it attacks the mammæ about the region of the nipple, and in all cases shows a preference for the softer regions of the trunk, especially the warmer parts, and also the inner surfaces of the limbs. In adults, the disease is never found either on the scalp or face—those parts being much exposed to cold—and only occasionally in infants. In young children, the buttocks and feet are often affected. It displays a preference for those parts of the skin which are subject to any pressure, as, for instance, beneath the stays, garters, or belt, and upon the buttocks of people who sit much. Scratching produces important secondary lesions—excoriations, torn papules, vesicles, and pustules—which result in crusts of blood, serum, and pus, and also general dermatitis, with infiltration, thickening, and pigmentation. Irritation is not always confined to the immediate neighbourhood of the acari, and the sympathetic itching caused by them, in distant parts, accounts for the widespread eruption apparently so out of proportion to the cause. Cases of so-called Norwegian scabies—which is a more serious, exaggerated, and chronic form, or an advanced stage of the same disease, resulting from neglect—have been known to last a lifetime. The whole integument becomes chronically inflamed and covered with pustules and extensive crusts, in which numerous acari and ova are found.

Diagnosis.—The only diseases with which scabies can be confounded are eczema and prurigo, and the following are the exact points which distinguish it from them:—The position of the eruption; the time and amount of irritation; the presence of burrows and acari; and the history of contagion. In scabies, the eruption is limited to certain parts—between the fingers or toes, fronts of wrists; while in eczema the erup-

tion spreads from the margin of the patches, and is never limited to these parts. In prurigo the hands are only slightly affected—usually only when there is secondary eczema—the characteristic parts attacked being the front and back of the trunk and the extensor surfaces of the limbs. The irritation in scabies is always worse when the skin is warm, but as this is also the case to a modified extent in both eczema and prurigo, the other points are the only certain signs whereby scabies may be distinguished from the two diseases mentioned.

Treatment.—This consists in the complete destruction of the acari and their ova. But, in order to do this effectively, it is necessary to open up the burrows in which they are concealed. This part of the treatment is at times rendered somewhat difficult by reason of the secondary eczema. The body should be soaked in a hot bath, after which all parts, where burrows are known to exist, should be freely rubbed with soft soap and a brush, and the entire surface then covered with an ointment containing some parasiticide. In this way the scabs will be removed, the burrows will be torn open, and the acari and their ova destroyed. After the process has been repeated once or twice, according to circumstances, the disease itself will be cured, although some eczema may remain as the result either of the disease or of the treatment. The effect of all parasiticides is more or less irritating, and as some people suffer much from them, care must be taken in their selection.

The two essentials in the treatment—that is to say, the opening up of the burrows and the destruction of the acari and ova—can be combined in one remedy, the lotion known as Vlemingx's solution, \mathcal{R} Calcis \mathfrak{z} ss., Sulph. precip. \mathfrak{z} j., Aq. destill. $\mathfrak{t}\mathfrak{z}$ v. This, rubbed in forcibly for half an hour and followed by a hot bath with plenty of soap, will often effect an immediate cure. But it is a rough method, and should only be used when time is a great object. A milder plan, and one almost as rapid in its results, is to combine the soft soap with the parasiticide, as in Hebra's modification of Wilkinson's ointment—Sulph. præcip. et picis liq. $\mathfrak{a}\mathfrak{a}$ \mathfrak{z} vj.; Saponis viridis et adipis $\mathfrak{a}\mathfrak{a}$ lb. j.; Cretæ \mathfrak{z} iv. Fiat unguentum.

The sulphur vapour bath is recommended by some authorities, but it is far less effectual than ointments. If the sulphur ointment of the B.P. be employed, it should be reduced to, at any rate, one-third its strength. It is necessary to remark

that the antiparasitic remedies should be discontinued as soon as possible, and that the subsequent eczema should be treated with soothing powders, lotions, or ointments. It is also important to note that the underclothes worn by the patient should be baked in an oven, so that all ova may be destroyed.

The following applications are all most useful for the destruction of the acari:—

℞ Olei cadini et sulph. præcip. āā ʒiij.; Glycerini amyli fʒvj.; Adipis benzoati ad ʒiij.

℞ Styracis liquidi fʒj.; Adipis ʒij.

℞ Styracis liquidi fʒj.; Sp. vini rect. fʒij.; Ol. olivæ fʒj. Fiat linimentum.

℞ Pulv. staphisagriæ ʒj.; Adipis ʒiij.

℞ Balsami Peruviani ʒss. vel ʒj.; Adipis ʒj. Suitable when for some special reason sulphur is not advisable.

℞ Naphthol. fʒss.; Adipis ʒj.

It is quite unnecessary to employ any internal treatment in Scabies.

MALCOLM MORRIS.

SCALDS. See BURNS.

SCALDS OF THE GLOTTIS are most commonly met with in infants or young children, from attempting to drink out of the spout of a kettle; or else in adults from the inhalation of steam in boiler accidents, or of ignited gas in explosions. In the latter, the lips and face, and even the whole body, are involved; in the former, the scalding steam is drawn into the interior of the larynx, and even into the trachea, by the sudden inspiration which precedes the cry of pain caused by the contact of the boiling water.

The severity of the injury presents considerable variations in each case. The mouth itself may escape so completely that, on casual inspection, there is nothing serious visible, while in reality the edges of the epiglottis are scorched and shrivelled, and the upper and back part of the larynx swollen and blistered; or the lips and tongue may be reddened and covered with vesicles full of exuded lymph, or with shreds of yellowish epithelium hanging down from the swollen papillæ. Sometimes, there is merely a slight degree of hyperæmia; at others, particularly if the fluid has entered the mouth, the epithelium is raised up and detached just as in scalds of the skin.

The *symptoms* are immediate, due to the injury itself, or remote, consequent on the inflammation that always ensues. Severe burning pain is always present: in

a child the screaming is incessant until, partly from exhaustion, partly from the œdema which very rapidly sets in wherever there is any loose connective tissue, the voice fails completely, and there is nothing to be heard but a hoarse, croupy inspiration. Often, the child tries to thrust its hand into its mouth or clutches wildly at its throat. Great restlessness and anxiety, or a continual sense of impending suffocation, are always present. Difficulty of swallowing sets in from the first; dyspnœa may also be immediate, but more often it becomes more marked in the course of a few hours, in consequence of the œdema and inflammation.

Exudation and swelling follow rapidly—most marked, of course, in the submucous tissue of the injured part, and particularly where the fibres are loose and yielding. By the root of the tongue, round the base of the epiglottis, and along the course of the folds leading from its sides to the arytenoid cartilages, are the favourite places. The ventricles are rarely much involved, and the true vocal cords, where there is no submucous tissue, hardly ever. The epiglottis itself may appear hard and shrivelled; the folds behind it are swollen up so that they can easily be felt with the finger, or seen, when the tongue is depressed, as smooth, round, semi-translucent masses on either side, reaching nearly across the middle line. Below, in the lower part of the larynx and trachea, similar changes, though of less severity, are not uncommon; probably due to the direct effect of the injury, although perhaps in some instances the result of extension of the inflammation. In short, the appearances are those of acute laryngitis, with more or less œdema of the glottis.

As this stage is reached, generally some few hours after the accident, and often preceded by a period of delusive repose, the symptoms become more and more grave. The dyspnœa, especially, increases slowly and surely, becoming worse the whole time, but interrupted now and then by paroxysmal attacks of asphyxia, each of which seems as if it would prove instantly fatal. Inspiration is much more impeded than expiration, especially in children; the breathing has a hoarse, croupy sound; the voice is completely lost; and with its chest thrown forwards and its chin upwards, so as to secure the greatest muscular aid, the child sits propped up, perfectly quiet, with its whole energy directed to its respiration. The face is pale and cyanosed, the lips dusky, the skin bedewed with perspiration, the pupils dilated, and all the symptoms of

asphyxia are present. At length the child sinks into a state of collapse, or death takes place suddenly during one of the paroxysms.

Later on, if this stage does not prove fatal, inflammatory affections of the bronchi and lungs ensue. The temperature rises, all the signs of fever set in, and a low insidious form of broncho-pneumonia makes its appearance—peculiarly dangerous not only in itself, but also from the circumstances which have preceded it, and the conditions under which it appears.

The *prognosis* is at all times exceedingly grave. The case may sometimes terminate fatally at once, from the shock of the injury. More often the symptoms subside for a short time, and then, especially at night, break out again with a succession of paroxysms, any one of which may be the last; and when this stage has passed, owing to the inflammation that follows, convalescence is always protracted and tedious.

Treatment.—The first object is to confine the inflammation following the injury within the narrowest possible limits, so that there may be free entry for the air, and that the lungs may not collapse or become involved by gradual extension of the mischief. Then, every care must be taken to prevent the access of anything that could irritate the larynx. The mucous membrane becomes intensely sensitive when it is inflamed, and what would hardly be noticed under ordinary conditions, or at most would give rise to a transient cough, may now excite such a paroxysm of spasmodic contraction that death ensues before any relief can be afforded. Finally, there is the question of tracheotomy, or, in children, of laryngo-tracheotomy, either as a preventive measure or to relieve already existing obstruction.

The temperature of the air breathed must be perfectly equable, and it ought to be saturated with moisture. This is best managed by surrounding the cot with curtains, and conducting the steam of a kettle into one corner; in this way cold draughts and dusty air may be completely excluded, but care must be taken not to raise the temperature too high, so as to avoid the intense depression caused by a warm moist atmosphere. Perfect rest is essential; but, as a rule, if the difficulty of breathing is at all great, the patient will remain perfectly quiet of himself. Ice round the neck, applied by means of a collar, and the continual sucking of small fragments, retaining them as long as possible in contact with the fauces, will help to keep the hyperæmia in check and to diminish the sensitiveness.

Bromide of potassium has been recommended for this purpose, but as a rule the symptoms come on before the drug has time to act. Leeches applied to the sternum or at the lower part of the neck, purgatives, and emetics—especially those which act like alum, without leaving behind any lasting depression—are of the greatest service in mild cases. Aconite and antimony are of use occasionally when there is a considerable rise of temperature, and small doses of calomel, gr. j. to gr. ij. every hour, until there are free bilious evacuations, enjoy a high reputation.

If, in spite of treatment, the dyspnoea continues to increase, and if, without there being any marked spasmodic attack, inspiration is becoming more difficult and the chest-walls are falling in, the choice will lie between free scarification of the swollen parts of the larynx, so as to procure the evacuation of as much exudation as possible, or opening the windpipe lower down. The former operation, particularly when the most swollen parts are the ary-epiglottic folds, which is usually the case, may be accomplished without much difficulty, either by means of an instrument devised for the purpose or with an ordinary sharp-pointed bistoury, of which all but the half-inch nearest the point has been guarded by a spirally wound piece of strapping. The folds can easily be felt with the forefinger of the left hand, and free incisions may be made on their upper surface. With reasonable care there is no danger of wounding any important structure, and it is surprising both how little of the exudation comes from a comparatively large wound, and how small that wound becomes when the part resumes its normal dimensions. The chief difficulty arises from the degree of dyspnoea from which the patient is already suffering, and from the spasmodic contraction sometimes induced when the finger touches the larynx.

It is best to postpone tracheotomy as long as possible, but it must not be forgotten that spasmodic contraction may come on with the slightest cause, even on movement, when a larynx is inflamed, and that any of these attacks may prove fatal. The operation gives, it is true, protection from one of the great dangers of this accident, and helps also to prevent collapse of the lung and subsequent hepatisation; but in a child it is a matter of some gravity, and it adds an additional cause for the inflammation of the bronchi and lungs which so commonly follows. But if tracheotomy is reserved to the last, and performed only in cases that are almost desperate, the ill

result must not be laid entirely to the credit of the operation. In all probability, if it were done at an earlier period and in a larger number of cases, instead of being reserved for those in which inflammation has already set in, and probably extended into the bronchi, the results would be very different. In any case it is advisable to insert a soft india-rubber tube as early as possible, so as to avoid the ulceration of the mucous membrane and necrosis of the cartilages, not uncommonly seen after the introduction of metal ones.

C. MANSELL MOULLIN.

SCALP, Injuries and Diseases of the. The skin covering the cranial vault is intimately connected, by means of strong fibrofatty tissue, with the tendon of the occipitofrontalis. These three structures constitute the scalp, whose inner surface, formed by the smooth aponeurosis of the muscle, is attached to the pericranium by loose areolar tissue and small vessels, and is freely movable over it.

HÆMATOMA, or a fluid blood-tumour of the scalp, is often the result of a blow. These tumours are situated either beneath the skin, beneath the aponeurosis, or beneath the pericranium. If blood collects between the skin and the aponeurosis, its amount must be very limited, as the tissue here is unyielding; but if it is poured out beneath the aponeurosis, the extravasation may be very extensive—sufficient indeed to lift the scalp away from the pericranium. It is limited in front and behind by the attachments of the occipito-frontalis, whilst laterally it descends as low as the zygoma, for the lateral edge of the tendon is continued to that bony process by a thin membrane which lies superficial to, but not in immediate relation with, the temporal fascia. Fortunately, the vessels in the subaponeurotic space are small, or this accident would be far from rare. A blood-collection which involves the separation of the pericranium from the skull is known as a **CEPHALHÆMATOMA**, and is necessarily limited to one bone by the dipping in of the pericranium at the sutures. It occurs commonly over the right parietal bone during parturition, or may follow a blow in an infant.

The *treatment* of blood-extravasation of the scalp should be conducted on those general principles which guide the surgeon in the management of hæmatomata occurring in other parts of the body. It should be mainly expectant, for, unless these collections are very extensive, the hope may be indulged in that they will clear up under

the influence of evaporating lotions, and an arrest of the movement of the scalp by means of strapping carefully applied. If these measures fail, antiseptic aspiration may be tried; but if any septic or inflammatory change occur within the tumour, free incision at dependent points must at once be practised, and the whole cavity washed out with some efficient antiseptic agent. Free drainage must then be provided for, and the dressing should be either gauze or wood-wool, impregnated with carbolic acid, iodoform, or corrosive sublimate. Shaving of the head is necessary, if the blood-extravasation be extensive and complete antisepsis be attempted.

WOUNDS OF THE SCALP partake of the same characters which distinguish wounds of other superficial regions. The incised, lacerated, and contused varieties are the most common. They are peculiar in the facts that they do not gape, and that, even if small, they may give rise to a good deal of bleeding, because the arteries lie in the subcutaneous fibrous tissue and are unable to either contract or retract—partly in consequence of the rigidity of this tissue, and partly as a result of the attachment of their outer coats to it. The partial division of vessels is another potent cause of profuse hæmorrhage from the scalp. This hæmorrhage can always be easily controlled by pressure. The bandages should be carefully applied without undue force, as more than one case has been reported in which a scalp bandage has produced sloughing of the cranial coverings. The hairs of the scalp are so strongly attached that cases are on record in which the scalp had been torn off by force conveyed through the hairs—the latter collectively possessing very considerable strength. Large portions, or even the whole, of the scalp may be stripped off from the vault of the skull without losing vitality, since the scalp carries its blood-supply with it, its arteries lying between the various layers of tissue of which it is composed. The danger of scalp wounds is coincident with and is chiefly caused by the opening up of the subaponeurotic space, the spread of inflammation being so easy in the loose areolar structure which intervenes between the tendon and the pericranium. If the bone is exposed by the stripping up of the pericranium it does not necessarily follow that it will necrose, as it is in most part nourished by the endosteal vessels. It is, however, undoubtedly a fact that the most common cause of intracranial inflammation is injury to the scalp, with stripping up of the pericranium.

Another noteworthy point about injury to the scalp, with exposure or bruising of bone, is that, should unhealthy inflammation ensue, the emissary veins may be the carriers of septic products into those of the diploë, or into the sinuses within the cranium. In either case a fatal pyæmia, preceded by thrombosis and ostitis, is likely to supervene.

Treatment.—Absolute cleanliness and antiseptics are of the first importance in the management of all scalp-wounds. If a large portion of scalp has been stripped off the cranium, infinite pains should be taken to make the whole aseptic by removing the hair and by diligent washing. The torn edges can then be united by sutures, counter-openings being made at dependent points, through which drainage-tubes should be inserted, and over all a carbolic gauze and salicylic wool dressing be accurately adjusted. Thus treated, cases oftentimes apparently the most severe convalesce, especially if the patient be young, with great rapidity. Wounds which do not pass through the occipito-frontalis tendon heal rapidly without any special treatment. Scabs are, however, apt to form over these trivial wounds, and it is necessary therefore to be careful that no wound-secretion remains pent up. Injuries of the scalp are especially dangerous in those cases in which other injuries would be serious, as in patients suffering from alcoholism or albuminuria, or the subjects of hæmophilia. In patients who are sodden with alcohol, delirium tremens, or a low form of inflammation accompanied by a low, muttering delirium, may ensue, which it will tax to the utmost the powers of the surgeon to subdue. In albuminuria, an asthenic form of inflammation is apt to come on which heralds a fatal issue. In hæmophilia, the wounds are best left entirely alone, exposed to the air without any interference. The only treatment which the writer has seen successfully adopted in such cases is the local application and internal administration of turpentine.

After all bad scalp-injuries the patient should be kept at rest for some days, the primæ viæ should be put in order, and the diet should be unstimulating, moderate in quantity, and largely composed of milk and foods made with milk.

INFLAMMATION readily occurs about a wound of the scalp if any secretion be pent up, or if asepsis be not attained. Shaving, free drainage, and poulticing will prevent its extension in most cases. It has, however, a tendency to assume an erysipelatous form, and then the whole scalp may become

‘boggy,’ and the course of the case will not be so simple. Much redness and swelling are not possible, on account of the anatomical peculiarities of the tissue. Inflammation is most serious when the sub-aponeurotic space is opened, or when the bone is laid bare by the stripping up of the pericranium.

Erysipelas of the Scalp usually follows a wound and may be caused either by the conveyance of infection from another patient, through the air, or by means of tainted sponges, instruments, &c., or may arise *de novo* under conditions which were apparently the least likely to produce it. The early diagnosis between local inflammation, with formation of pus underneath the scalp, and an attack of erysipelas, is in some instances difficult. In the former case the inflammatory focus would be more or less limited and defined, and must have been preceded by local injury. The pus would, moreover (if formed), bag at the dependent and attached borders of the scalp. In the latter case the general constitutional symptoms would probably be more marked, and, at the very commencement of the attack, vomiting and enlargement of the cervical glands would be important points to note. *Cutaneous erysipelas* of the scalp commonly extends to the face, and can usually be with ease subdued by frequently changed warm compresses of lead lotion and by nutritious diet. The temperature may range up to 102° or 103° Fahr., and for two or three nights the patient may suffer from a little delirium. In those cases in which the whole thickness of the scalp is involved and the bone is bare, we have to deal with a *cellulitis* which is extremely dangerous; but, even in the worst cases, free incisions, antiseptic washings, ample diet, perchloride of iron and quinine, with stimulants, will do a great deal to bring about recovery.

Abscess of the scalp is small and unimportant if situated above the aponeurosis, and commonly happens from the scabbing over of a wound before the deeper parts are healed. If pus forms beneath the aponeurosis, the collection may be very extensive and serious. The treatment consists in shaving, free incision at dependent points—above the zygoma, at the upper margin of the orbits or in the occipital region—with antiseptic irrigation and dressings. The *sinuses* which remain after a large abscess of the scalp has been evacuated are sometimes difficult to close. The best way is to adopt Mr. Hilton’s plan of securing rest to the scalp by well-applied strapping. *Abscess in the temporal fossa* may be

mentioned in this place. The pus tends to pass down beneath the zygoma, and does not point above it in consequence of the extreme density and strength of the temporal fascia. It should be opened above the zygoma as soon as deep fluctuation can be felt.

Boils and carbuncles occur upon the scalp. A carbuncle in this region may be most serious. It may commence in the soft parts covering the skull or extend to them after first attacking neighbouring parts, such as the back of the neck. *See BOILS; CARBUNCLE.*

SIMPLE AND MALIGNANT TUMOURS are by no means uncommon on the scalp.

Sebaceous cyst is the most usual form of simple tumour. If congenital, it is known by the name of *dermoid cyst*, occurs frequently near the outer angle of the orbit, and often involves the wall of the cranium. When placed in the median line, the diagnosis from meningocele is almost impossible. *See MENINGOCELE.* Sebaceous cysts, which are not of congenital origin, occur at any age after puberty, but most frequently in middle life. They may be multiple, and by their gradual increase in size during many years may, in rare cases, involve the cranial vault. The orifice of the obstructed follicle is generally visible, and the tumour itself is round or oval, tense, freely movable, hard, or fluctuating. These cysts can be removed by dissection, or by transfixion and subsequent avulsion of the wall of the sac. No part of the latter must be left, or troublesome after-consequences will ensue. These operations should never be lightly undertaken, and never except in persons in perfect health. The removal of a congenital cyst is more difficult, partly on account of its greater depth from the surface, and in part on account of the thinness and delicacy of the cyst-wall, and the adhesion of the latter to the bone. When a sebaceous cyst ulcerates, the diagnosis from epithelioma is not easy. The base of the ulcerated cyst is movable and not very hard; the granulations exuberant, and there is no evidence of surface-decay; the discharge is offensive, and the glands in the neck might be enlarged. *See SEBACEOUS CYSTS.*

Epithelioma generally commences as a crack or pimple, and there would be no history of a previous cyst. The base would be hard and fixed, and if at certain points vegetative outgrowths were apparent, the general tendency would exhibit an eroding and destructive character. *Rodent ulcer* not infrequently attacks the scalp primarily,

but it may do so secondarily after destroying a portion of the face. *See under CARCINOMA; ULCERS.*

The *treatment* of epithelioma and rodent cancer is wide excision. An ulcerated sebaceous cyst must also be excised. In epithelioma the glands in the neck may be implicated so much, by the time the patient is seen, as to make operation unjustifiable. In rodent cancer, the disease must be removed, even if it extends into the bone; and at the close of such an operation, the application of chloride of zinc paste is most useful.

Syphilitic ulceration of the scalp is occasionally most intractable.

The *pachydermatous tumour* of the scalp is very rare. It is a localised fibrous change affecting the skin and deeper tissues. It is movable, and causes much deformity. It has been successfully removed by the knife, but it is best for the surgeon not to interfere. When *multiple subcutaneous fibrous tumours* are found upon a patient, one of them may be discovered beneath the skin of the scalp. Outgrowths from the skull, such as *exostoses* and *nodes*, must not be mistaken for scalp-diseases.

For *Nævus* of the scalp, *see NÆVUS.*

PULSATING TUMOURS OF THE SCALP.

1. *Aneurism* of a scalp-artery takes place after some injury—usually partial division of a vessel. It is rare, has the typical signs of aneurism, varies from the size of a pea to that of a bean, and can be cured by either pressure or excision.

2. The common seat of *cirsoid aneurism* is the scalp. It is formed by a congeries of dilated vessels, which pulsate with a loud systolic bruit. The skin over the tumour is hotter and thinner than elsewhere, and the unaltered cranial vault can be palpated through the worm-like mass of the tumour. *See CIRROID ANEURISM.*

3. *Hernia cerebri.* *See BRAIN, Hernia of the.*

4. *Encephalocele.* *See MENINGOCELE.*

5. *Sarcomata of the dura mater or cranium*, if rapidly growing, pulsate. The pulsation is not affected by compression of the arteries of the scalp, and pressure upon the tumour does not produce cerebral symptoms. The tumour is perfectly fixed, and evidently attached to or continuous with the bone. Egg-shell crackling may be present. The diagnosis can rarely be made at such an early period as to justify operative measures.

6. *Pulsating hæmatoma* containing cerebro-spinal fluid as well as blood. For a description of this form of pulsating tumour, *see MENINGOCELE.*

For cutaneous and parasitic affections of the scalp, *see* TINEA TONSURANS; PEDICULI; HORNS. CHARLES A. BALLANCE.

SCALPELS are small knives which are used for most surgical operations requiring dissection. There are three patterns of scalpels, which differ from one another slightly in the way the point is made. The common operating scalpel is sharpened on one edge only, and both edges are rounded off towards the point, so that the latter is in a line with the middle of the blade. In another pattern, the back of the scalpel is sharpened for about half an inch near the point; in a third, the cutting edge only is rounded off, and the back of the scalpel runs straight on into the point.

SCAPULA, Diseases of the.—A large variety of tumours is found connected with the scapula. By far the greater number start from the bone itself, and gradually involve the entire scapula, the muscles and soft structures attached to it, the shoulder-joint and clavicle, and are malignant. The ordinary growths, met with in other regions, present the same characters here as elsewhere.

FIBROMATA spring from the muscular or fascial tissues covering the scapula; they are firm in texture, slow of growth, generally lobulated, circumscribed and encapsuled, not often painful, and when removed, as a rule, do not return.

SARCOMATA.—These growths are either parosteal, in the tissues superficial to the bone, periosteal, or central, in their origin; the last form generally occurring in the medullary structure of the neck of the scapula, whilst the first two are usually associated with the body or borders of the bone. The diagnosis between the parosteal and periosteal forms is scarcely possible, as the former often so closely invest the bone that the mobility of the tumour underneath the muscles of the scapula is difficult to detect. Hence, it is not until the tumour has been cut down upon that any determination, as to the extent of the operative proceeding, can be arrived at. The parosteal form may be carefully removed from the bone, whilst the periosteal and central require excision of the scapula.

The *diagnosis* of these growths is always fairly easy. Generally, they have gained such hold, when the patient comes under observation, that the clavicle, and possibly the head or neck of the humerus, and the soft tissues of the head, neck, and axilla, are already involved. The growth

is usually well-defined; its surface possibly lobulated, and somewhat elastic on palpation; it is very rapid in development, and the subcutaneous veins are enlarged and prominent. There may or may not be pain; this must depend upon the invasion of the growth.

The sarcomata are most frequent in young subjects at about the age of puberty, and are possibly associated with some injury to the shoulder, although they often appear spontaneously. They are very malignant, and their growth and recurrence after removal are rapid, the latter occurring locally or in some viscus.

ENCHONDROMA is sometimes met with, springing either from the venter, dorsum, or, more frequently, one of the processes. It is uniformly firm in consistence, often nodular, painless, and of slow growth, although occasionally this is not the case.

GUMMATA are sometimes met with about the scapula. When occurring in the muscular structures, they may assume the appearance of real growth, and, as they are almost invariably of rapid development, may be mistaken for sarcoma. The history of the case will aid the diagnosis, and the exhibition of specific treatment in such cases of doubt is of the greatest value, the gumma speedily disappearing under its use. When gummata are situated superficially, they may simulate abscess.

ABSCCESS may be either quite superficial or develop in the supra- or infra-spinous fossæ, beneath the fascia, as the result of injury, or spontaneously, unassociated with any disease of the scapulo-humeral articulation. It often commences as acute inflammation of some bursa, and the matter remains for a time pent up by the dense fasciæ, and eventually makes its way either towards the surface or into the axilla.

Subscapular abscess not infrequently occurs in the loose connective-tissue between the subscapularis and serratus magnus, and is most frequently a result of some lymphatic absorption, although it may occur spontaneously, and after some local injury. The ordinary symptoms of fluctuation—at first, at any rate—may be absent, as the collection of pus is so deep; but the high temperature, the throbbing pain, and the separation of the scapula from the thorax, together with the increasing inability to move the arm, and the gradual filling up of the axillary hollow, all point to the probability of abscess. An exploratory puncture should complete the diagnosis.

BURSAL TUMOURS.—The large bursa between the inferior angle and the thorax is

sometimes so enlarged as to present the appearance of a rapidly growing malignant tumour. It is usually noticed as the result of some over-strain or exertion, such as may be produced by rowing, cricket, or tennis. It appears as a tense, fluctuating tumour, pushing up the scapula and often encroaching on the axilla. If the growth be of long standing, its walls become much thickened, and it may be readily mistaken for a solid tumour. Occasionally, these enlarged bursæ contain melon-seed bodies, and on pressure or manipulation crepitus is detected; here, again, puncture with a trocar or aspirator reveals the nature of the swelling. Persons following particular trades develop bursæ over the scapula; thus bricklayers' labourers and porters frequently have an enlargement of the bursa immediately over the anterior edge of the trapezius. Such tumours occasionally suppurate.

PERIOSTITIS and OSTITIS, acute and chronic, are occasionally met with, and may be limited to certain portions of the bone or involve it entirely. They are sometimes due to struma or syphilis, occur spontaneously or as the result of exposure or injury, but more frequently are secondary to disease in the scapulo-humeral articulation or head of the humerus. The symptoms are much the same as in any other region; although, from the dense muscular and fascial coverings, the diagnosis is, at any rate in the early stages, not always easy. There is deep-seated pain referred to the bone itself, a rigor, and rise in temperature; swelling and œdema of the soft parts do not usually appear as rapidly as in the case of the more exposed and less embedded bones, but if the inflammatory attack be severe, suppuration is usually very rapid and diffuse. The resulting abscess points either in the axilla or in the supra- or infra-spinous fossæ.

NECROSIS of the scapula, either partial or entire, is generally the result of the above conditions, and when sinuses have formed, a probe will detect bare bone. The periosteum is very often detached entire, so that operative interference is comparatively easy when the diseased tissue is exposed.

DISPLACEMENT OF THE SCAPULA.—The peculiar condition, to which this term has been applied, is a displacement of the lower angle and spinal border of the scapula, whereby the bone seems to be lifted away from the thorax. It was formerly considered to be due to the scapula shifting from under the latissimus dorsi, but it is

now known to be the result of paralysis of the serratus magnus muscle, which may be partial or complete. The remarkable tilting up of the bone is due to the preponderance of power in the trapezius, levator anguli scapulæ, rhomboidei, and pectoralis minor.

The *diagnosis* is easy. If the arms are held forward, at right angles to the trunk, the elevation of the spinal border of the affected side is most marked, and the patient can project the sound arm about two inches further from the thorax than the affected one. The movements of rotation of the bone are either feeble or wanting on the affected side; in fact, the serratus magnus is incapable of performing its special functions.

Electricity seems the chief element in *treatment*; and Erichsen states that he has seen much benefit derived from the endermic application of strychnine on a blistered surface, followed by support by means of some properly devised apparatus.

EDWARD BELLAMY.

SCAPULA, Dislocations of the.—Dislocations at the acromio-clavicular joint are sometimes described as dislocations of the acromial end of the clavicle, but they are more correctly classed as dislocations of the acromion process of the scapula. This may be displaced *downwards* or *upwards*.

DISLOCATION DOWNWARDS, though not a frequent injury, is far more common than dislocation upwards, and this is to be explained partly by the direction of the force, and partly by the direction of the articular facet, which on the acromion looks upwards and inwards. The injury is caused by a fall on the point of the shoulder, and the resulting deformity is easily recognised. The acromion process falls below its proper level, and the outer extremity of the clavicle rides upon it. The end of the clavicle forms a very distinct projection immediately beneath the skin, the nature of which it is scarcely possible to mistake. By drawing the shoulder well back and at the same time raising it slightly, the dislocation is easily reduced, but the deformity recurs immediately the support is removed; and thus, both in its tendency to relaxation, and in the extra mobility it occasions, this dislocation forms an exception to the rule. The difficulty of retaining the bone in position is so great that some have given it up as hopeless, and South recommended that no trouble should be taken, the clavicle being allowed to unite by fibrous tissue to the acromion, in its abnormal position. With great care and a tractable patient,

however, it is possible to obtain a cure without deformity. In other cases, the writer would suggest that it may be justifiable to excise the joint and wire the bones together; but it should be remembered that, if the bones are united in the dislocated position, the arm remains useful and but little weakened.

To reduce the dislocation, one hand should draw the shoulder well back, whilst the other is used to raise the elbow. To retain the bones in position, it is usual to place the arm in bandages similar to those used for fractured clavicle, but, in the writer's opinion, bandaging alone is wholly inefficient. He advises as follows:—A little absorbent cotton-wool, covered with zinc powder, should be placed in the axilla to prevent intertrigo; the arm should be carried forward so that the hand rests on the other clavicle, and the elbow be then forced upwards and outwards. Broad strips of Holland plaster (which does not stretch) should next be used to bind the arm to the side, and, to support the elbow and arm, strips should be carried over the opposite shoulder; a soft pad should be placed on the clavicle, and a broad strip of plaster be carried from the back over the pad and under the elbow. When the surgeon has tested the efficiency of the strapping, he should protect any prominences of bone with cotton-wool, and then cover the whole with plaster of Paris bandages. M. Laugier in eleven cases employed a tourniquet to keep down the clavicle. The arm should be fixed for six weeks.

DISLOCATION UPWARDS is very rare, and is caused by force applied to the upper surface of the clavicle. Besides rupture of the acromio-clavicular ligaments, the conoid and trapezoid give way. The rotundity of the shoulder is lost, and two bony projections appear, the upper and inner formed by the acromion, and the lower and outer by the end of the clavicle. The humerus rotates without difficulty, but the patient cannot raise his hand to his head. Reduction is accomplished by drawing the shoulder back, after which it is necessary to confine the arm to the side for five or six weeks.

Dislocation of the Coracoid Process upon the Clavicle was described in 1843 by Godemer, who related five cases as having come under his notice in five years, since which time M. Pinjon has added a sixth. Malgaigne throws doubt on the extraordinary experience of his compatriot, suggesting that both in the symptoms and in the effect of treatment the cases resemble

each other too closely to be all taken from nature. This dislocation must therefore be left for further experience to establish.

R. CLEMENT LUCAS.

SCAPULA, Excision of the.—This operation is indicated in cases of necrosis or of new growths. It is not without its difficulties, and these of course vary with the size or situation of the tumour; hence, any typical operation can scarcely be described. Such operations may be considered as (1) total resection or extirpation, in which the shoulder-joint is opened, and the glenoid cavity removed; (2) removal of the scapula, leaving the glenoid cavity and shoulder-joint, the neck being divided by a saw; and (3) resection of certain portions of the bone, especially of the spine, angles, or acromion process.

If it be necessary to remove the entire scapula, the most convenient method is as follows:—The subclavian artery being controlled by an assistant, and the arm extended from the side, an incision is to be made along the posterior border of the bone, and a second one along the spine, joining the first and terminating at the tip of the acromion. The triangular flaps so formed are next to be dissected off, thus exposing the mass to be removed. The muscles attached to the posterior border are then to be divided close to the bone, so as to allow of its being grasped by the hand and lifted off the thorax. The knife is then carried along the upper border, dividing all muscular attachments. The acromion process may be either disarticulated from the clavicle or cut through with forceps, or, what is preferable, the acromial end of the collar-bone divided. The muscular attachments along the axillary border should next be divided, and it is at this stage of the operation that the bleeding may be troublesome. The vessels should be clamped or tied as divided. The mass is then fairly free, and, being still further lifted up, the joint is next opened and the disarticulation effected, the remaining muscular attachments being divided, and the bone removed, the vessels ligatured or torsioned, and the flaps adjusted as in any ordinary amputation.

Subperiosteal resection is performed in cases of necrosis, and the bone being exposed by the above incisions, by means of rugines the periosteum may be stripped off; the attachments of the several muscles being preserved. There are several instances recorded of the entire scapula and its processes being removed subperiosteally with complete reproduction.

The actual operative proceeding is as follows:—An incision is made from the tip of the acromion to the base of the spinous process; a second incision is next to be made, commencing at the superior angle and following the spinal border of the scapula, terminating at the inferior angle. The incisions are carried through the periosteum. This membrane is first stripped off the acromion, next the spine, taking care to preserve the attachments of the deltoid and trapezius. The posterior border is then to be denuded, with the attachments of the rhomboidei. The periosteum should next be removed from the infraspinous fossa, and the infraspinatus and teres minor separated, followed by the detachment of the supraspinatus from its fossa. The articulation is next attacked on its posterior aspect, and the capsular ligament turned up from its attachment to the neck of the bone. The arm should now be extended, and the inferior angle of the scapula lifted up, and the bone thus tilted from within outwards. This exposes the subscapular fossa, and, on lifting the bone still further from the thorax, the anterior aspect of the capsule should be scraped off and opened. The bone should next be seized by strong forceps and twisted outwards. Such are the directions laid down by Ollier, as an exercise, presumably, on the cadaver, but in actual practice the separation of the periosteum, if not already complete pathologically, is of very easy performance, and has been practised with the most satisfactory results.

EDWARD BELLAMY.

SCAPULA, Fractures of the.—This bone is so movable, its processes are so strong, and it is for the most part so thickly covered with muscles, that it is very seldom broken. Its fractures are almost invariably due to direct and considerable violence; very rarely to muscular action. They are divided into those of (a) *the body*, (b) *the neck*, (c) *the acromion*, (d) *the coracoid process*.

Fracture of the Body is caused by the passage of a wheel, by falls on the back upon a projecting stone or the like, or by a heavy blow. Though often transverse, its rays may extend upwards through the spine, or obliquely through its anterior or posterior border. It is often starred or comminuted.

Symptoms.—These are mobility of the fragments when the bone is grasped at different parts, or when the inferior angle is grasped, or the hand placed flat on the bone, while the arm is moved by an assistant;

accompanying crepitus, often a mere click, caught only on one particular movement. In fracture of the spine or of the borders, particularly in thin persons, displacement may be detected. In fractures below the spine, the lower fragment is generally found in front of the upper, and carried upwards, so that the bone is shortened from above downwards. But this is by no means constant.

Treatment.—Such readjustment as may be possible having been effected by manipulation, the scapula should be covered with a carefully moulded and well-padded gutta-percha shield for protection, and the arm fixed by bandaging in the position in which the fragments are found to be most easily maintained in place. Some deformity will probably remain, but this will usually not impair the functions of the arm.

Fracture of the Neck.—There appears to be no example in any museum of fracture of the anatomical neck of the scapula—that is, of a fracture detaching merely the glenoid cavity, and it may be very strongly doubted whether this injury ever occurs. There are, however, dissected specimens showing fracture through the surgical neck; that is, through the narrow part by which the glenoid cavity and coracoid process together are attached to the remainder of the bone.

Symptoms.—In this rare accident, always the result of a crush or other form of direct violence, the shoulder is somewhat flattened, as in dislocation of the humerus; the normal outline may be restored, and perhaps crepitus felt, when the elbow is raised; but deformity returns when the arm is allowed to hang down. The humerus is abnormally movable in all directions, and its head can be felt in the armpit. The patient is unable to raise the arm, and passive movement causes severe pain.

Treatment consists in placing a pad in the axilla; raising the arm, and supporting it by means of a firm sling acting on the elbow and forearm, and bandaging the arm to the side and the forearm across the chest. Movement, which is likely to be much impaired, may be improved by manipulating the limb, under an anæsthetic, at the end of six weeks, and subsequently employing passive movements, combined with hot douching and shampooing. Fracture of the margin of the glenoid cavity, or a stellate fracture of this cavity, is sometimes present as a complication of dislocation of the humerus. See SHOULDER-JOINT, Dislocations of the.

FRACTURE OF THE ACROMION is caused by falls on the shoulder or by a blow from above. The size of the fragment varies, and may include merely the tip or the whole process to the root of the spine. The injury is rare. Many supposed fractures with ligamentous union are instances of separation of the acromion, apparently at the line of junction of the epiphysis with the rest of the bone, in the course of rheumatic arthritis. In St. Bartholomew's Hospital Museum is a specimen of this kind, in which the acromion is divided into two pieces, one of which is still connected with the spine by a very narrow bridge of bone, the other, at the tip, being joined to the first piece by fibrous tissue.

Symptoms are dropping and flattening of the shoulder, pain, loss of power to raise the arm, displacement, and the rough edge of the fracture felt on passing the finger along the bone. The deformity is removed by elevating the arm—when probably crepitus can be felt—but returns when the arm is allowed to hang down.

Treatment.—A pad having been placed in the axilla, the arm must be supported in a sling, and bandaged across the chest, as in fractured clavicle. Union is generally fibrous, but there is slight if any impairment of the functions of the limb. Bony union might probably be secured by confining the patient to bed, and raising the arm, so that dragging on the fragment might be prevented.

FRACTURE OF THE CORACOID PROCESS, *see* CORACOID PROCESS, Fracture of the.

HOWARD MARSH.

SCARIFICATION. — A method of local blood-letting, extremely limited in scope and generally of doubtful utility.

The operation consists merely in making a number of small, very superficial cuts, which may be crossed by others, and allowing the blood to ooze from them.

It is sometimes recommended in conjunctival chemosis, in the early stages of acute tonsillitis, in œdema and engorgement about the glottis, and in certain conditions of the os uteri. On the skin it is useless.

WILLIAM H. BENNETT.

SCHIZOMYCETES. — *Synon.* Bacteria, bacteridæ, vibrios, schistomycetes, micro-organisms, microbes, microzymes, cocco-bacteria.

Schizomycetes is the classical name, now in general use, to express the whole class of micro-organisms formerly known indefinitely as bacteria, that term being now

restricted to one genus. It signifies the fact that organisms of this class reproduce themselves by fission of the parent organism, and this is the case with all species, though not the only method in several.

This class of organisms was arranged by Cohn in the following order of genera, which has been found to be by far the most practical:—

MORPHOLOGY.—A. *Coccus* forms.—Spherical or oval organisms; subdivided by Billroth into micrococcus and megacoccus. *See* MICROCOCCUS.

B. *Bacterium* (q.v.).—A short, oval, or cylindrical rod-shaped organism, with rounded ends, or also an ellipsoidal shape constricted in the middle like a biscuit (clithridium). In any case the length of the organism does not exceed twice its breadth.

Varieties of bacterium are frequently provided with a flagellum.

C. *Bacillus* (q.v.).—Rod-shaped organisms, in which the length of the adult element is much greater than its breadth. This is perhaps the most important genus.

D. *Vibrio* (q.v.) is practically a curved bacillus, the curves (1–2 in number) being always in the same plane.

E. *Spirillum* (q.v.) is a spiral-shaped thread, which when greatly overgrown has received the name spirochæta, these latter forms being also more flexible.

Habitat.—These organisms are found in varying quantities in the air, in water, and in the soil. The quantity in the air of temperate climates varies according to the height from the earth, to the action of the wind in raising dust, and temperature—i.e. according to the season of the year. Some species attack and inhabit the interstices of living animal tissues, while very many exist as parasites on the cutaneous and mucous surfaces of the body.

Structure.—All the schizomycetes consist of a protoplasmic body, containing small fat and sulphur particles, and staining readily with anilin dyes. This protoplasmic body or core is surrounded by a sheath, which possesses many characters of cellulose, and offers powerful resistance to many chemical reagents. The protoplasm is an albuminous substance, the basis of which is an albuminoid compound termed mycoprotein, which contains no combined sulphur. In several species the protoplasm is pigmented, the prevailing colours being yellow, orange, red, and blue.

LIFE CHANGES. — *Respiratory*. — All forms require oxygen, and give out carbonic acid. Most need free oxygen, and there-

fore are termed aerobic; others can probably take the oxygen from combination, and hence have been termed anaerobic; but this division is not satisfactory. In some (bacilli), the growth when exposed to free oxygen tends to spore-formation.

Thermic.—All forms grow best at about 36° C. (96·8° F.). All adult forms are killed at 50° C. (122° F.) moist heat, and by severe cold. Spores, however, survive much greater extremes, viz. 120° C. (248° F.) dry heat.

Very few forms can grow in pabulum which is kept in rapid motion (e.g. blood, &c.). Light appears slightly to retard growth, and electricity also, but this latter probably by electrolysing the pabulum.

Chemical.—These organisms split up both simple and complex substances to gain the necessary elements for their nutrition. They require hydrogen, nitrogen, oxygen, and carbon, while at the same time it is essential that there should be a trace of phosphate in the nutrient fluid. As results of the catalytic action of their life, fats, albuminoids, and carbohydrates are broken up in a way that can be imitated by the action of superheated steam and potash, so that it is probably a process of hydration. Thus, fats become rancid from the development of butyric acid, &c.; the carbohydrates and glycerine are decomposed into alcohol, butyric and carbonic acids; albumins are broken up into glycocoll, leucin, tyrosin, and aromatic compounds, while the former again are resolved into ammonias and lower acids.

On living tissues the schizomycetes appear to exert a progressive necrotic action, partly due to their breaking up the tissue for nutrition, and partly, perhaps, to the effect upon the healthy tissue of the products of such decomposition. *See SEPSIN; SEPTIC DISEASES, Classification and Etiology of.*

REPRODUCTION.—This is effected either by fission or spores.

(a) *Fission.*—According to the elevation or depression of the surrounding temperature, an adult organism will quickly or slowly divide into two, usually first elongating, but in rapid subdivision the daughter elements are very short, so that the primary elongation is slight. In the rod forms, the subdivision is always at right angles to the direction of the long axis. In the coccus forms, the subdivision takes place in every direction, and thus sarcinoid groups of four or more result. Vibrio forms appear to possess the power of vacuolating and then dividing longitudinally

(Klein). When organisms grow rapidly by fission, they form masses termed zoo-glœa, the individual organisms composing which are held together by an albuminous substance, which sometimes forms a gelatinous envelope.

(b) *Spores.*—In the presence of free oxygen, many bacilli tend to grow into long threads (leptothrix), in the interior of which there develop brightly refracting spots which by atrophy of the rest of their filamentous sheath become free, as oval protoplasmic masses surrounded by a very resisting sheath. A similar process of spore-formation may be seen in adult rods. These bodies are spores, and, under suitable conditions, will elongate and develop into single rods. They possess fully three times the power of resisting destruction by heat, chemical reagents, &c., that the adult rods do, and, consequently, play an extremely important part in the etiology of diseases such as malignant pustule, &c.

Practical Importance.—The practical importance, to the surgeon, of the existence and life-processes of these parasitic organisms cannot perhaps be exaggerated; but since this point involves the question of fermentation and etiology of infective diseases, it is fully described in the article on SEPTIC DISEASES, and need not be repeated here. The treatment of the different conditions, with which micro-organisms are actively concerned, will also be found under the various septic diseases.

VICTOR HORSLEY.

SCIATIC HERNIA.—This form of rupture is very rare. The protrusion escapes through the great sacro-sciatic foramen. The fundus of the sac is found beneath the gluteus maximus muscle; the neck may be either above or below the pyriformis, and will be in front of the gluteal artery, and below the obturator. Sir Astley Cooper has reported a case where a piece of ileum was strangulated in this position. The hernia was not discovered until after death. The hernial orifice could be readily examined by introducing the hand into the rectum.

FREDERICK TREVES.

SCIRRHUS. *See* CARCINOMA; BREAST, Diseases of the.

SCLEREMA NEONATORUM.—*Definition.*—An induration of the skin, with lowered temperature, occurring congenitally or soon after birth. Until Parrot distinguished between the two affections, sclerema and œdema neonatorum were mixed up together.

Etiology.—Sclerema may be primary or secondary. The primary cases are either congenital, or occur in a very few days after birth, without apparent cause. The secondary cases are the sequel of causes which depress vitality, such as diarrhœa or pulmonary affections, like pneumonia, with collapse or atelectasis; it is apt to occur with malnutrition from bad feeding and defective hygiene. Œdema happens, almost invariably, in infants which are premature or of otherwise feeble vitality, and there, too, atelectasis is frequent; bad feeding of mother and child, or exposure to cold immediately after birth, are also causes.

Pathology.—Langer considers the first condition a 'fat sclerema'—i.e. due to solidification of the fat; infantile fat having a much higher melting point than adult fat. On the other hand, Parrot regards it as a consequence of desiccation of the tissues from the drain of diarrhœa, &c.

Œdema is presumably due to the feeble circulation and defective aëration of the blood at a period when vital resistance is always small.

Symptoms.—When not congenital, the induration generally begins in the lower limbs—rarely in the face—within ten days of birth, spreads to the trunk, and is usually complete over the whole body-surface by the fourth day from its commencement; but it may remain incomplete. At first, the skin is of a yellowish-white or waxy appearance, but it soon gives way to a slightly livid tint, and the skin becoming adherent to the subjacent tissues as well as rigid, it cannot be pinched up, and there is no pitting on pressure. The skin is tense, smooth, cold, and hard. The limbs and jaw are fixed, the eyes closed, and the child lies motionless with the exception of slight movements of the thorax and face, the latter being less rigid than other parts; but the stiffness of the lids and cheeks prevents sucking, the pulse, respiration, and temperature sink far below the normal, and life is completely extinguished within a week.

Œdema begins in the third day of life, with drowsiness, swelling of the extremities, especially of the legs, which pit on firm and prolonged pressure, and are cold and livid. The œdema spreads up to the thighs, then to the hands, the genitals, and back; the soles and pubes are especially affected, and are red and hard, sometimes doughy. The drowsiness increases, the pulse gets feeble, the respiration slow and shallow, and complications, such as pulmonary af-

fections, with collapse, diarrhœa, or convulsions, hasten the fatal issue; jaundice sometimes supervenes just before death. Recovery takes place in some cases, if they come early under treatment.

Diagnosis.—Though so much alike in etiology, and in the depression of the vital processes, these two affections may be distinguished by the following points:—

In sclerema, the disease is general; the skin, tense, hard, and waxy in colour, does not pit, and cannot be pinched up.

In œdema, the disease is less widely spread, the skin is livid from the first, not so hard as sclerema, pits on firm pressure, and can be pinched up, while the swelling is always greatest at the lowest parts. In sclerema the joints and jaw are stiff; not so in œdema, or only in a slight degree.

The onset so soon after birth is alone sufficient to distinguish both forms from scleroderma, in which no case under two years has been recorded.

Prognosis.—Death invariably ensues in a few days, when the induration is universal; but in the rare, incomplete cases recovery may be hoped for. In œdema the prospect is not quite so hopeless, though always serious, and the cases last longer.

Treatment.—Efforts must be made to keep up the temperature; the child should therefore be wrapped in cotton-wool, and surrounded by hot-water bottles; friction of the limbs with oil is also a useful measure. As the child cannot suck, food must be introduced into the stomach by a small stomach-pump tube passed through the nose, or by Battam's plan of attaching an india-rubber tube to the nozzle of a glass syringe, passing it into the pharynx, and then injecting the food; peptonised milk and white-wine whey are suitable aliments, for digestion, like the other functions, is at its lowest ebb.

H. RADCLIFFE CROCKER.

SCLERODERMA, or hide-bound disease.

Definition.—A subacute or chronic disease, characterised by extreme induration and rigidity of the skin.

This disease is a rare one, and has nothing in common with sclerema neonatorum, except the hardness of the skin, which is due to a different cause. There are three classes of cases: one in which the skin-affection is diffuse and symmetrical, another in which it is circumscribed, and a third or mixed class which partakes of the characters of both the other forms. The first two require, to some extent, separate con-

sideration, as the symptoms and etiology are in many respects very different.

Etiology.—Females are much more prone to this disease than males, in the proportion of three to one in the case of diffuse, and a still larger proportion in circumscribed scleroderma. It may occur at all ages from two years and upwards, but is most frequent in young and middle-aged adults. In diffuse scleroderma, previous attacks of acute rheumatism and erysipelas are the most frequent remote antecedents, and exposure to wet or cold is the most frequent exciting cause. Cases that follow from definite conditions are generally acute in their onset; while, frequently, no cause can be traced for those which are slow and insidious in their development; and, in many instances, the patient has been in good health until attacked with scleroderma.

The cause of the circumscribed form is quite obscure. In many there is a history of worry, anxiety, or other depressing mental influence antecedent to the appearance of the patches; in a few, chiefly band cases, local irritation or injury appeared to be the exciting cause; whilst the rest seemed to be spontaneous in their development.

DIFFUSE SYMMETRICAL SCLERODERMA.
Symptoms.—These cases are seen in two phases: one where the skin is swollen, the other where it is shrunken. The first is usually, but incorrectly, ascribed to hypertrophy, but is really due to infiltration; and the shrunken state is one of atrophy. The swollen stage is the early condition, and may be quite hard from the first, or stiffly œdematous; and the shrunken stage is a sequel to the œdematous variety.

The common history is that the disease came on after exposure to cold or wet, arthritic pains and perhaps the symptoms of subacute rheumatism sometimes attending the onset; or there may be no other symptoms except those of the skin. A feeling of stiffness of the skin is first experienced, hindering movement, and attended by a sense of tension; and the affected part becomes quite hard, rigid, and cannot be pinched up. This symptom may come on quite suddenly, or so slowly and insidiously that the patient is scarcely aware of its commencement.

The upper half of the body is most frequently attacked, the stiffness being first felt in the back of the neck, the chest, shoulders, or arms. Once started, the process may spread slowly or rapidly over a large area, or even over the whole body-surface;

but the lower half is never attacked without the upper being involved, though the converse often happens. Whatever be the extent—and the disease is often very erratic in its distribution—symmetry is preserved. The palms and soles are rarely involved, but any of the mucous membranes may be affected. The edge of the affected area merges imperceptibly into the surrounding skin, while the affected part is extremely tense, and, when the parts beneath are affected, the muscles feel as if rigor mortis had set in. No pitting can be produced on pressure, and no fold can be pinched up; the surface is pale and marbled by dilated small vessels, and sometimes pigmented to a varying extent. If the face is involved, the features are as fixed as those of a statue, and when the trunk is attacked, respiration is interfered with; while in the limbs the joints are immovable and more or less flexed from contraction of the distended skin.

There is no alteration in the sensibility, but itching is sometimes troublesome, and sweating is more or less in abeyance. Subcutaneous tubercles, like rheumatic nodules, have been observed in a few instances.

In the œdematous cases, instead of induration a stiff œdema is present at the commencement, and the real nature of the disease may be unsuspected at first. After lasting some weeks or months, the œdema gets absorbed, the skin shrinks, acquires a dead or ivory-white hue, and the atrophic stage is developed. This atrophic condition is usually less widely spread than the œdema which preceded it, and is often confined to the limbs and face, but the symmetry is retained. The skin is now as tense as before, but from contraction, not distension; in the face the skin is strained over the bones, and may be directly adherent to the periosteum from compression-atrophy of the fat and muscles; the lips are drawn up, the gums retracted, and the teeth in extreme cases fall out. The countenance is bloodless, except where mottled by telangiectases, and the fixed features and straining of the skin over the bones give a ghastly corpse-like aspect; the limbs of an adult may be reduced to the size of a child's, the joints ankylosed, and the hand claw-like. In consequence of the tension of the skin over the joints, ulcerations, sometimes attended with necrosis, easily ensue from slight injuries.

The course taken by these two forms varies somewhat; the tensely infiltrated cases tend to clear up sooner or later, the infiltration is gradually absorbed, the skin

becomes less rigid, and after some months, but in some cases not for years, the skin gradually regains its normal softness and elasticity. Some think that these cases may also merge into the atrophic form, but this is not the opinion of the writer. Progress may be interrupted if the patient get a chill, and even extension may then ensue, and, according to patients' statements, the skin is tighter on some days than others. In the contracted cases recovery is less frequent, the disease often remains stationary for years, or it may extend at long intervals. The general nutrition suffers, and the patient gradually sinks or dies from intercurrent disease. It is a long time, however, before the general health suffers, and many seem to be little the worse except from their helplessness.

No special complications, except rheumatism and valvular heart-affections, are found associated with this disease, but other eruptions may be present, and filaria sanguinis hominis has been twice found.

CIRCUMSCRIBED SCLERODERMA, or MORPHEA, is, by some authors, still regarded as an entirely independent disease; but the other view gains ground, and will doubtless eventually prevail.

Symptoms.—It occurs in patches and bands, the former being the most common. The patches, which may be single or multiple, are usually from half to two inches or more in diameter, situated generally on one side of the body, often in the course of a nerve, like herpes zoster, but sometimes in the middle line, sometimes bilaterally, and occasionally symmetrically. They develop gradually, rarely rapidly, without any symptoms. The domain of the fifth nerve, the breasts, and still more frequently the limbs, are favourite positions, but they may come anywhere.

The majority of the patches are of an ivory-white colour, smooth and dry, surrounded by a pink or violet zone of minute dilated vessels; but this zone may be absent, and the patch more or less pigmented in various hues. The edge may be diffused or defined, its shape is as irregular as its size; it may be raised above (*M. tuberosa*), depressed below, or level with the surrounding skin. No difficulty is usually experienced in pinching up the diseased skin, and as it is rarely adherent to the subjacent tissues, and is quite superficial, it feels like parchment or leather, according to its thickness, which varies often in the same patch. As a rule, when once it is developed there is no increase in size, but sometimes small atrophic spots appear

close to the major patch, enlarge, and coalesce with it.

Defects of sensibility are rare, but there is itching in some cases. In the band cases, the lesion is usually single, and, unlike the patches, is often adherent to the subjacent tissues, so that it is sunk into a sulcus below the healthy skin; but if non-adherent it may be raised up into a ridge.

Pathology.—The pathology of this affection is obscure, but the process does not appear to be inflammatory, and the theory most in accordance with the clinical facts is that of an obstruction of the arterial blood-supply to the skin, on the one hand, and the venous and lymph flow on the other; and the varying symptoms of different cases depend upon the relative degree of obstruction in one or other of these vascular systems. But what the primary defect is that brings this about is not known, and it must be inferred that it is of central nervous origin, and in fact that the disease is primarily a central tropho- or vasomotor-neurosis. Diffuse scleroderma has been anatomically examined by many, and the results, omitting minor differences, are as follows:—The changes are, in the main, in the deeper parts of the corium and subjacent tissues, and consist of narrowing of the lumen of the blood-vessels and accumulation of cells round them.

Later on there is destruction of the sweat and sebaceous glands and hair-follicles, and absorption of the fat and cellular tissue by the pressure of these cells, and a great development of connective and elastic tissue bundles, doubtless from fibrillation of the cells; and the skin may become directly adherent to the fascia or periosteum.

The anatomy of circumscribed scleroderma has been examined by the writer. The changes were of very similar character to those of the diffuse form, but were more superficial, affecting the upper part only of the corium, in the early stage; and thrombi were present in many of the vessels, explaining the pallor and thinning present at first. At a later stage there was increase of the connective tissue, and the changes had spread into the deep part of the corium and into the fat layer. In the opinion of the writer, the obstruction to the arterial blood-supply is greater than in diffuse scleroderma, and so atrophic changes are more often produced. Probably the nervous defect is not central, affecting perhaps only single nerves in this class of cases.

Diagnosis.—The wooden induration and immobility of the skin and subcutaneous tissues, occurring symmetrically over a wide

area, with or without the ivory colour supervening, are conditions almost peculiar to diffuse scleroderma, with the sole exception of sclerema of the newborn, in which there is induration with great coldness of the surface; this, and the age of the patient, would be obvious distinctions. There remains only one disease, even rarer than scleroderma, which may give rise to some doubt—namely, diffuse primary or secondary cancer of the skin—the '*Cancer en cuirasse*' of Velpeau. If secondary, it often begins with nodules; this and the previous history would remove all doubt, but in the primary cases there may be more difficulty. The slow, continuous spreading, the lancinating pains and tenderness, the neighbouring inflammatory œdema, the ulceration of the lesions and involvement of the glands, with the more rapid course of marasmus and fatal cachexia, are all points in which it differs from scleroderma.

Circumscribed scleroderma presents even less difficulty. The raised patches might perhaps be mistaken for the keloid of Alibert, but the difference in colour, the ivory-white tint of morphœa being absent, and the presence of vessels upon the tubercle, and the claw-like processes which extend from it, would distinguish this affection. The flat patches are quite distinctive, and no confusion could arise with ordinary care.

Treatment.—In the diffuse form, the indications are to guard the patient against cold, since aggravation and extension are very likely to follow a chill, to which the patients are abnormally prone; secondly, to improve the general nutrition; and thirdly, to restore the circulation in the ischæmic area. For the first, the patient should be clothed in flannel, never allowed to go out in cold winds, and guarded carefully against draughts.

For the second, ferruginous and other tonics suitable to the individual should be given, and cod-liver oil is often very beneficial. The digestive organs should be carefully attended to, since they partake often in the general enfeeblement, and flatulence aggravates the distressing tension when the trunk is affected.

For the third, shampooing should be systematically and diligently employed to the affected areas. Turkish baths are useful before the rubbing, but vapour baths are too depressing.

Where Turkish baths are not available, inunctions with neat's-foot or olive oil, or simple unguents are useful; galvanism is strongly recommended by some, and may

be of service, probably, by improving the circulation.

Iodide of potassium, arsenic, and mercury have been repeatedly tried and found useless, and mercurial inunctions have been decidedly injurious in many cases.

The treatment of morphœa is very unsatisfactory; nothing has any direct effect for good, and anything producing local irritation aggravates the mischief. General invigorating measures are useful, and nerve-tonics, such as the mineral acids and nuxvomica, are often indicated. Galvanism has been recommended, but must be used so as not to irritate the patch; but if employed in the neighbourhood may be beneficial. Inunction may also be tried with simple ointments, always remembering that, if not worried by injudicious treatment, the patches tend to get well of themselves eventually. Mercury, internally or externally, should be avoided. The mixed cases should be treated in the same way as diffuse symmetrical cases.

H. RADCLIFFE CROCKER.

SCLEROSIS. See INDURATION.

SCLEROTIC, Diseases of the.—*Anatomy.*—The sclerotic is the white, tough fibrous membrane which constitutes five-sixths of the outer coat of the eyeball. In front, it is continuous with the transparent cornea; behind, with the sheaths of the optic nerve and with the connective tissue investing the fasciculi of the nerve (*lamina cribrosa*). That portion of it which may be seen within the opened eyelids, through the semi-transparent conjunctiva, is called 'the white of the eye.' Externally, it is smooth, except where the tendons of the muscles are inserted, and is enclosed by a thin fibrous covering—the episclera—lined with endothelial cells. This covering—the so-called 'capsule of Tenon'—which also furnishes the sheaths to the straight and the oblique muscles, is very loosely attached to the sclerotic, except in front, where, at about one-eighth of an inch from the periphery of the cornea, it becomes intimately blended with both the conjunctiva and the sclerotic, and cannot be separated from either without laceration. The sclerotic is lined by endothelial cells containing more or less pigment, and is loosely connected with the underlying choroid by many delicate connective-tissue fibres, nerves, and blood-vessels. It is chiefly composed of bundles of fine fibrillæ, among which a few elastic fibres are scattered. The bundles of fibrillæ are irregularly arranged into

layers, which interlace at various angles. Most of the bundles have either a circular or an antero-posterior direction, and a smaller number are disposed obliquely. Around the entrance of the optic nerve, as well as near the cornea, the circular bundles predominate. Among and between the layers is a system of lymphatic channels with spaces containing fixed cells, closely resembling those of the cornea. Most of the cells are unpigmented, but a few are pigmented. The latter are found chiefly around the entrance of the optic nerve, and in the deeper layers of the sclerotic near the cornea. In negroes and dark races generally, the proportion of pigmented cells is always greater. Migratory cells also circulate in the lymphatic channels.

The sclerotic has comparatively few blood-vessels and nerves. It receives a few small branches from all the ciliary arteries and veins. These vessels form a wide-meshed plexus, chiefly on the surface, in which, as a rule, two veins accompany each artery (Leber). On the anterior surface, around the margin of the cornea, the distribution of the blood-vessels is peculiar. At about one-twelfth to one-eighth of an inch from the cornea, the anterior ciliary arteries, which are the terminations of those supplying the straight muscles, divide into—(a) perforating branches, which pass through the sclerotic to go to the ciliary body, where they join the posterior ciliary arteries, and (b) superficial branches, which lie in the episcleral tissue and anastomose by arched communications in the neighbourhood of the corneal margin. The latter are called episcleral arteries. From these arcades two sets of branches arise—one consisting of small straight vessels which run up to and within the limbus of the cornea, and form with the subjacent episcleral veins the marginal vascular plexus of the cornea; the other consisting of vessels which bend backwards, to end in the conjunctiva and anastomose with the posterior conjunctival vessels. The circumcorneal vascular plexus or ring is therefore made up of episcleral and the anterior conjunctival vessels, which freely communicate with each other, and are directly connected with the vessels supplying the anterior portion of the conjunctiva, the sclerotic, the cornea, the ciliary, and the iris. Hence, in inflammation affecting these parts, the marginal plexus, which in health is almost invisible, becomes more or less conspicuous, forming what is generally called ‘the zone of ciliary injection.’

Pathology.—Containing few blood-vessels, nerves, cells, and lymphatics, and

subservient only the functions of an exoskeleton, the sclerotic is a comparatively indifferent structure; its composition is stable, its nutritive processes are sluggish and not easily diverted. Consequently, it is but little susceptible of disturbing influences, and is subject to few pathological changes. Indeed, when these changes do occur, they are generally associated with and dependent upon morbid states of one or more of the adjacent textures—namely, the ciliary body, the choroid, or the iris, or, much more rarely, the cornea.

It is at first sight remarkable that, notwithstanding the unbroken structural continuity, the sclerotic proper is seldom much affected in inflammation of the cornea; though it readily participates in inflammation of the iris and ciliary body, to which it is contiguous only. The explanation seems to be, that the nutrition of the cornea is, in the main, distinct from that of the sclerotic, and that both these structures are alike primarily dependent upon the integrity of the ciliary body for their organic maintenance.

The commonest inflammatory manifestation, referable to the sclerotic, is now known to involve rather the episcleral tissue than the substance of the sclerotic. The morbid state is still, however, often spoken of indiscriminately as scleritis or scleritis and episcleritis. The truth is that though episcleritis may occur alone, it is not infrequently associated with inflammation of the sclerotic. The concurrence is to be accounted for partly by the nature of the inflammation and its exciting cause, but chiefly by the anatomical peculiarities of its situation. From what has been already stated respecting the relations of the episcleral capsule and the sclerotic, it will easily be understood that the further the focus of disease from the cornea, the less likelihood of a concurrence of scleritis and episcleritis, and *vice versâ*. Near the cornea, the union between the two is so close and intimate as to come near to identity of structure, while at a distance the connection is both slight and readily separable.

Nosology.—The principal morbid states of the sclerotic and episclera are:—Hyperæmia, episcleritis, scleritis, staphyloma, and tumours; they are also subject to some slight congenital abnormalities.

HYPERÆMIA.—Hyperæmia of the scleral and episcleral vessels is usually indicative of a morbid state of the cornea, iris, ciliary body, or choroid; or it may signify obstruction to the intraocular circulation, due either

to increased intraocular pressure, or to some other cause. It occurs in two forms—(a) as a pink or, more commonly, a purplish zone, patch, or crescent, at the margin of the cornea; and (b) as large varicose vessels running over the surface of the sclerotic, from about the margin of the cornea towards one or other of the straight muscles.

(a) The former is the more frequent form. Typically, it consists of a purplish zone, varying in breadth from one-eighth to one-fifth of an inch, immediately surrounding the cornea. On examining this zone more closely, it will be found to be made up of the minute radiating blood-vessels described above by the name of *episcleral vessels*. In some cases the injection does not entirely surround the cornea. With the redness there is usually some swelling, due partly to the engorgement of the blood-vessels, and partly to infiltration of the episcleral tissue. The conjunctiva with its vessels may, by gentle pressure and friction upon the edge of one or other lid, be made to glide over the enlarged vessels, which obviously lie upon the surface of the sclerotic. If the conjunctiva also be inflamed, the scleral and episcleral vessels may be masked to some extent by the congested conjunctival vessels, which are distinguishable by their reticular arrangement, and by being largest and most conspicuous towards the lacunar portion of the conjunctival sac.

(b) The varicose state of the scleral vessels is most frequently met with in chronic inflammation of the sclerotic, iris, ciliary body, or choroid, and is generally present in glaucomatous eyes. It may, however, be due to pressure or other disturbances behind the eyeball, either within the orbit or beyond it.

EPISCLERITIS is an inflammation of the loose fibrous covering of the sclerotic. The inflammation may be strictly limited to the episcleral tissue, or it may involve likewise the conjunctiva on the one hand and the sclerotic on the other, or both these structures may be concurrently implicated.

Objectively, episcleritis consists of a more or less circumscribed dusky-red or purplish swelling on 'the white of the eye,' under the conjunctiva, and near the cornea, or within one-third of an inch of it. The most frequent seats are near the corneal limbus, and opposite the insertion of one of the recti tendons, especially the external. The vessels of the overlying conjunctiva are generally enlarged, but the mucous membrane itself is, in the earlier stages at least, freely movable over the swelling.

When the swelling is close to the edge of the cornea, the adjacent portion of the cornea becomes hazy from infiltration into its layers and from disturbance of the epithelium. Eventually, the affected area of the cornea may ulcerate. The sclerotic itself rarely if ever ulcerates in true episcleritis. In some cases, iritis complicates episcleritis; and, more rarely, there is cyclitis.

The *subjective* symptoms are variable. The pain is not usually severe, and does not amount to more than a sense of discomfort, with, perhaps, a dull aching sensation when the eyeball is moved or the eye is used for near work. On the other hand, there is sometimes great pain of a neuralgic character, not only in the globe, but also around the orbit and down the side of the nose. In these cases, however, it will generally be found that there is, in addition to the episcleritis, inflammation of the cornea, or the iris, or even the ciliary body itself. Nor is the sight affected, unless one or other of these parts be implicated.

The *course* of the disease is very chronic. As swelling leaves one part, it may reappear in another, and in this way the case may be prolonged for months. The average duration is about from two to four months.

Termination.—The inflammation may disappear without leaving any traces behind it, or at most only some thickening of the episcleral tissue. In a few cases, a faint discoloured patch persists on the surface of the sclerotic. But if the cornea have been involved, a nebula or actual leucoma may remain.

Clinical Varieties.—At least four distinct varieties of episcleritis may be met with—namely, (1) a circumscribed, indolent, purplish swelling appears opposite the insertion of one of the recti tendons and under the conjunctiva. There is little or no pain, watering, or distress of light. This form may occur during an attack of acute rheumatism, and it is probably always associated with the rheumatic diathesis.

(2) The episcleral swelling is not so circumscribed, and is situated near to the cornea. The conjunctival vessels are enlarged, and there is a patch, or may be, zone of injection at the margin of the cornea. There is also congestion of the iris, as evidenced by a small amount of discoloration and a semi-contracted state of the pupil. The eye waters, cannot bear exposure to light or to cold and damp air. The pain is often very great, both in the eyeball and in the brow. Such cases were formerly spoken of as examples of catarrho-rheu-

matic ophthalmia (Mackenzie). In some cases actual iritis may occur.

(3) Episcleritis may complicate, or be complicated, by phlyctenular ophthalmia. In chronic or recurrent marginal phlyctenular keratitis, the inflammation may extend to the episcleral tissue, and in some cases, following the course of the vessels, it may spread thence through the sclerotic to the ciliary body and iris.

(4) An episcleral infiltration-patch forms near the corneal margin. In a few days the adjoining portion of the cornea is seen to be hazy and its epithelium roughened, and, in the course of one week or more, the infiltration-patch may gradually desert the episclera altogether, to invade the cornea. The softened cornea may then disintegrate and a deep ulcer result. The ulcer, too, often assumes a serpiginous character, and spreads along the margin of the cornea and over the surface; or, running down to the posterior elastic membrane, leads to bulging of the posterior elastic membrane, with prolapse of the iris and ultimate perforation. This form is chiefly met with in anæmic and debilitated persons, especially women weakened through suckling or exhausting illnesses. There may not be much pain in this form, though there is usually great distress of light. The serpiginous form of episcleritis is probably neuropathic. In most of the cases which have come under the writer's observation, there have been other evidences of faulty innervation.

Causes.—Episcleritis occurs chiefly in young and middle-aged adults, rarely in children or in old persons, and it is more frequent in women than in men. The common exciting causes seem to be rheumatism, gout, syphilis, and scrofula. It is sometimes associated with uterine disease, catamenial disorders, and occurs during pregnancy or after parturition.

Treatment.—The *local* treatment should be soothing. Irritants of every kind are contraindicated. In recent cases, moist warmth, as steam-spray fomentations, is generally agreeable and useful. Sometimes, however, moist warmth increases the pain. In any case, glycerine of belladonna, or weak mercurial ointment containing extract of belladonna, may be applied with gentle friction to the brow or temple, and a solution of atropine may be applied to the conjunctiva, and repeated if found not to irritate. Pain is generally relieved and the duration of the disease shortened by systematic diaphoresis, whether induced by Turkish or other hot baths, draughts or

subcutaneous injections of pilocarpine, or in any other way. Sulphate of quinine, with small doses of calomel (gr. $\frac{1}{6}$ to gr. $\frac{1}{2}$ three times a day), seems, in many cases, to promote the absorption of the inflammatory matters. De Wecker speaks highly of the combination of copious sweatings with the internal administration of salicylate of soda. In chronic cases, blisters may be applied every ten days to the temples, and astringent compresses every night to the closed eyelids. In chronic cases, with opacity of the cornea, *massage* of the eye repeated many times a day has been recommended by Pagenstecher. If there be inflammation or ulceration of the cornea, with a deep anterior chamber and increased intraocular tension, sclerotomy may be tried and repeated at discretion.

SCLEROTITIS.—Idiopathic scleritis seldom, if ever, occurs; inflammation of the sclerotic being generally secondary to iritis, or cyclitis, or choroiditis. *See* CHOROID, CILIARY BODY, IRIS, Diseases of the.

STAPHYLOMA OF THE SCLEROTIC is comparatively rare, and is the result either of injury with laceration or of inflammation of some portion of the uveal tract.

The common situations are—the corneoscleral margin, the ciliary region, the equator, and the posterior pole, just outside the optic nerve.

NEW GROWTHS are very rare, so-called tumours of the sclerotic being really growths which have invaded the sclerotic rather than originated in it. Still, fibrous growths and sarcomata do sometimes occur.

Treatment will depend upon the nature of the growth. Malignant tumours cannot be removed too early, even though the eye be certainly sacrificed by the operation. *See* ORBIT, Tumours of the.

JOHN TWEEDY.

SCLEROTIC, Injuries of the.—The sclerotic is liable to all and any of the injuries which affect soft parts—namely, blows and concussions, contusions, wounds, ruptures, burns, scalds, the effects of corrosives, and other chemical irritants and caustics.

BLOWS, CONCUSSIONS, or CONTUSIONS may be *simple*—that is, affect only the sclerotic—or *complicated* by injury to the adjacent parts. The principal complications are, contusion or wound of the lids or the cornea; subconjunctival ecchymosis; paralysis of one or more of the recti muscles; detachment or laceration of the choroid, iris, retina, suspensory ligament, or the capsule of the lens; hæmorrhage into the anterior chamber, the vitreous, behind the retina or

the choroid; concussion or even laceration of the optic nerve; paralysis of the sphincter pupillæ; suspension of the accommodation.

The nature and extent of the injury may be temporarily masked by hæmorrhage into the anterior chamber or the vitreous, or by the early occurrence of inflammation, or by the presence of old or recent opacity of the cornea or the crystalline lens. It should be remembered that lacerations of the retina and choroid from blows upon the sclerotic rarely, if ever, take place at the site of the blow, but are almost always at the posterior pole of the globe, and are more or less concentric with the optic nerve. More rarely, the rupture occurs in the anterior part of the choroid, but then there is also rupture in the posterior part and in the same meridian (Arlt).

Treatment must be to a large extent palliative and expectant only. The eye should be protected by a shade or by a light cooling compress. Complications and sequelæ must be treated according to their special indications.

WOUNDS of the sclerotic are, as a rule, very dangerous, because, first, of the degree of violence necessary to produce them; secondly, they are often attended by lesions of the cornea, iris, choroid, retina, crystalline lens, and vitreous; thirdly, they are frequently followed by grave pathological changes, such as inflammation, suppuration, cataract, detachment of the retina, glaucoma, or sympathetic ophthalmitis; and fourthly, they are often difficult to close, partly in consequence of the elasticity of the sclerotic, and partly from the tendency of the choroid or other of the intra-ocular contents to protrude into the wound and become entangled therein.

Wounds of the sclerotic may be *simple*—that is, involve only the sclerotic—or *complicated*. The *simple* wounds are—incised, contused, lacerated, punctured, ruptured, and gunshot. The *complicated* are those with rupture, or with protrusion, or even extrusion of the iris, ciliary body, choroid, retina, vitreous, suspensory ligament, or the crystalline lens itself; those with intra-ocular hæmorrhage, or with lodgment of a foreign body in the wound or within the globe.

Uncomplicated wounds of the sclerotic are comparatively rare, there being in most cases some prolapse of a portion of the uveal tract. When the wound is the result of great violence, and is inflicted by a large blunt instrument, there is almost always laceration of the choroid, with protrusion or extrusion of the vitreous or of the crystalline lens.

In blows with the fist, the rupture of the sclerotic does not take place at the point of impact, but in the ciliary region on the opposite side of the cornea; the usual situation being just outside the cornea and concentric with it, or opposite the interval between the superior and internal recti. But when the blow comes from above, then the lower part of the sclerotic may be torn. If the rupture take place quite close to the cornea, the conjunctiva is also torn, and the lens is forced out of the eye; but when it is more than, say, about one-twelfth of an inch away, the conjunctiva escapes, and the extruded contents of the globe lie under it as in a cyst.

It may be stated generally, that wounds of the sclerotic are dangerous in proportion to the degree of violence with which they were inflicted, the amount of protrusion and entanglement of the iris, choroid, &c., and their nearness to what is called 'the ciliary region.' Other things being equal, a small wound in the ciliary region is much more dangerous than a much larger wound elsewhere; and if there be entanglement of the iris or ciliary body, the risks are very greatly increased. So common is sympathetic ophthalmitis under such circumstances, that this part of the sclerotic is often spoken of as 'the dangerous region.' See SYMPATHETIC OPHTHALMITIS. Again, wounds of the sclerotic, with lodgment of a foreign body within the globe, are necessarily more serious than those without.

Treatment.—The first duty is to endeavour to ascertain the nature and extent of the injury, the second to calculate on the one hand the prospects of good and safe recovery, and of the risks of sympathetic ophthalmitis on the other.

If the eye be obviously destroyed, excision should be performed without delay. Perplexity only arises when, in spite of much apparent injury, there is a fair amount of sight, or when there is only a small wound but in a dangerous region. On the one hand, extensive laceration of the sclerotic may heal and a useful eye result; on the other, even a small wound in the ciliary region, with entanglement, is always, as already stated, a possible source of danger from sympathetic ophthalmitis.

If it be determined to try to save an eye, the lips of the wound should as far as practicable be cleared of all entanglements; all prolapsed tissues being returned or excised. If the wound be large, a stitch may be necessary to prevent escape of vitreous. This should be inserted by using a suture with a fine curved needle attached

to each end, and passing the needles separately from within outwards. The eyelids should then be closed by a light compress of boric or iodoform wool. Atropine, or eserine, according to the special indications, should be instilled two or three times a day.

In cases of rupture of the sclerotic, where there is complete extrusion of the lens under the unbroken conjunctiva, no attempt should be made to take away the lens for some weeks, so that the sclerotic may have time to heal. When this has taken place the conjunctiva may be divided, and the lens let out. If, however, the lens be entangled in the wound, it should be removed as soon as possible, in order to allow the lips of the sclerotic to fall into apposition.

In penetrating wounds of the sclerotic, with lodgment of a foreign body within the globe, excision will, as a rule, be called for, unless the foreign body be a fragment of iron and so placed as to be easily accessible to forceps or to the electro-magnet.

BURNS of the sclerotic are always accompanied by corresponding lesions to the CONJUNCTIVA, CORNEA, and EYELIDS, and do not therefore call for any special notice.

JOHN TWEEDY.

SCLEROTOMY. See GLAUCOMA.

SCOTOMA, a blind spot on the retina, the result of disease. See PERIMETRY.

SCROFULA or **STRUMA** is a condition of malnutrition of the tissues; it is not a disease but a diathesis—in other words, a tendency to certain forms of diseased action, most marked in infancy and youth, yet sometimes occurring in old age, when the body is naturally less well nourished, under the name *senile scrofula*.

The causes of this condition are—(1) Inheritance; (2) bad or insufficient food; (3) overcrowding, ill-ventilation, darkness and dampness of dwelling; (4) insalubrious climate.

(1) Parents suffering from, and in a less degree those who have suffered from, scrofula and its near relation tubercle, beget as a rule scrofulous children. The degree of scrofulosis, in different members of the offspring, varies with innumerable combinations of this cause with the other causes named above; as also with the health of either or both parents at the time of impregnation, and with the condition of the scrofulous or tuberculous mother during gestation. Probably, no child of scrofulous parents is entirely free of the taint, but, if all the other

above-named conditions be absent, it may escape any local manifestation. Probably, on the other hand, it may be affirmed that a sufficiently intense combination of the above with faulty hygiene will produce scrofula, in a child of parents however healthy.

(2) The milk of a scrofulous mother certainly increases the evil she has imparted; it is even probable that suckling by a scrofulous nurse may implant the diathesis in a congenitally healthy infant. The administration of farinaceous food, before the secretion of saliva is established, has considerable influence in the production of scrofula, or at least in calling forth scrofulous manifestations. This conclusion has been forced upon the writer by observation of several cases, notably of seven in which, when such mode of feeding was stopped, the outbreak ceased. Insufficient food with excess of starch, bad quality and monotony of diet, all have, in their degree, a like effect.

(3) That overcrowding is a potent generator of scrofula is indubitable. Breathing again and again an atmosphere already exhausted by other lungs is bad enough, even if those other lungs be healthy; but recent researches render it highly probable that scrofulous emanations from one person may produce that disease in another individual. Overcrowding implies also dirt, interfering with the action of the skin, and usually causes darkness. The action of light on the body is hardly sufficiently appreciated. The effect of its absence is analogous to the etiolation of plants.

(4) Scrofula is chiefly rife in climates which, like that of Britain, are damp, cold for the greater part of the year, and always uncertain. We know, however, from history, that two and even three hundred years ago 'the king's evil' was very prevalent, and it must be, in the present day, very difficult to apportion aright its cause between heredity and other conditions. Replies, however, to the writer's inquiries show that strumous families taking up residence in America, New Zealand, and Australia, (save in overcrowded parts of seaboard towns) so lose their proclivity, that the younger members, born strumous here, cease to exhibit manifestations after emigration, and that the parents procreate healthy children.

Pathology.—The strumous diathesis, without local manifestation, possesses no pathological anatomy hitherto demonstrable; it is probable, however, that the faulty nutrition mentioned in the opening sentence consists in some want of equilibrium, structural or functional, between the lym-

phatic rootlets or spaces and the other elements of the connective tissues. Whether this want of balance be primary, or whether it be dependent on some faulty condition of blood, or again whether it produces, or is produced by, minute anatomical variations from normal texture and fabric, more especially of the adenoid constituents of tissue, is not yet ascertained. But it is certain that this diathesis, when strongly developed, is marked by certain characteristics of external form, due to peculiarities in thickness and abundance, or in fineness and paucity, of the connective (areolar) tissue; and these characteristics are more especially impressed on such parts as are largely made up of lymphoid or adenoid structures.

These peculiarities are associated with a proclivity to follow up 'any slight and transient irritation by a chronic inflammatory process, which not only outlasts the irritation, but spreads or continues independently of it, usually resulting in suppuration or caseation, and rarely assuming the form of a pure hyperplasia' (Billroth). And in these conditions it is found that lymphatic tissues, notably the glands and such parts as contain abundance of adenoid elements, are especially vulnerable. But even the parts, thus suffering from strumous inflammation, betray no anatomical peculiarities differentiating them generically from parts affected with non-strumous chronic inflammation, until the resulting products undergo certain degenerations. It is, indeed, this tendency of the inflammation to continue, while its products are averse to organisation, which constitutes the characteristic of strumous manifestations, by producing a great accumulation of the most embryonic of inflammatory fabrics—granulation-tissue. This tissue is, however, common to all forms of subacute and chronic inflammations; in struma, its persistence, and therefore its amount, is alone to a certain extent peculiar.

But here attention must be called to certain minute bodies, very apt to form in the midst of this tissue, wherever interstitial cell-growth has much exceeded the rate of vessel-formation. Thus, non-vascular islets appear in which, equidistant on every side from the great vessels, nodules, are developed consisting externally of a delicate reticulum supporting lymphoid cells; further inward, of epithelioid cells; and centrally of larger branched cells, sometimes of giant-cells. For, wherever a portion of growing inflammatory product becomes extravascular, giant-cells commonly occur. These little spots are named by Rindfleisch, 'newly-

developed lymphatic follicles.' It is possible, however, that they indicate a tendency to organisation or to fibrillation—at least an abortive attempt at those actions, for Ziegler, by placing under the skin of dogs two cover-glasses, kept so far apart as to allow of granulation-tissue insinuating itself between them, found on their removal a number of very similar spots (only he called the epithelioid cells fibroblasts) formed of exactly similar elements. These bodies are therefore in no way distinctive of struma, they are found in old indolent ulcers, in the so-called proud-flesh (*caro luxurians*) of unhealed wounds and of burns, in the granulation-tissue surrounding sequestra, and in the thick granulation-material of very chronic synovitis. Nevertheless, though not distinctive of, they are most common in struma, because persistency of inflammatory products is most usual in that dyscrasia.

But to continue the life-history of granulation-tissue, which by its very nature must be merely transitional, and if it will not organise, must of necessity degenerate. Hence, unless fibrillation or cicatrisation set in, suppuration, together with much fatty degeneration, caseation, or tuberculisation will occur.

It is still unknown whether the cause of this imperfect tissue-nutrition is intrinsic in the tissues themselves or in the blood. Some support of the latter doctrine is afforded by two facts—that the blood of a large proportion of scrofulous persons contains an undue amount of lymphoid elements (leucocytes), and that two inflammatory manifestations of scrofula are rarely simultaneous. A belief in the humoral origin of the diathesis originated its treatment by setons and issues, to exhaust the blood of its peccant material.

The *diagnosis* of scrofula, the diathesis in contradistinction to the manifestations, depends on the appreciation of certain personal characteristics which are of two types, corresponding the one to fineness and paucity, the other to coarseness and abundance, of connective tissues. The former is marked by refinement and definition of the features. The curves of the lips, the nasal, aural, and tarsal cartilages are finely modelled. The conjunctiva and sclerotic are so thin that the pigment of the choroid, partially seen through them, imparts a bluish or pearl-grey colour to the white of the eye; the skin, clear and pure of tint, with cool-toned, ash-grey shadows, is so translucent that the bluish, wavy course of subjacent veins is plainly marked, as on the

upper eyelid, the temple, angle of the jaw, &c.; the luscious redness of the lips testifies to the same condition. The eyelashes are abundant and long—a fine down, often rather long, extends from the margin of the scalp-hair some way down the forehead, temples, and nape. The whole aspect is of refined but fragile beauty.

The other type is coarse and ugly. The head large and lumpy, bigger behind than before, is flanked by large, red, puffy ears; the jaws are prominent, the lips thick, ill-defined, and often cracked, sway clumsily apart. The nose is lumpish, the origin of the alæ ill-defined, the eyelids thick and clumsy, often even when not inflamed bordered with red, are frequently lined with dried Meibomian secretion clinging to the roots of sparse irregular lashes. The dull, unclean-looking skin is marked by large orifices of sebaceous ducts. The figure is usually ungainly, the joints and extremities large, the belly prominent; the hair coarse, either of a dull sandy colour or lustreless black. These descriptions are taken from the extremes of each type; to discriminate what degree of tendency either way may justify the practitioner in considering his patient scrofulous, requires acumen and experience. His judgment will be aided by considering the family history, the age of the patient, and the kind of malady he may be required to treat.

The manifestations of scrofula affect: (1) The skin; (2) mucous membranes; (3) lymphatic glands; (4) joints; (5) bones.

(1) The scalp is especially liable to eczema, tinea, and favus; the face to lupus; scrofulous ulcers, though chiefly choosing the neck, also occur at the bends of joints. Chilblain is said to be chiefly common in strumous persons, probably an error due to the obstinacy of all inflammations in such individuals.

(2) Phlyctenular ophthalmia, ulcerative corneitis, tinea tarsi, chronic catarrhs, catarrhal bronchitis, enlargement of tonsils and thickening of pharyngeal adenoid tissues, persistent coryza, ozæna, otorrhœa, purulent vulvitis and vaginitis.

(3) Enlargement of lymphatic glands, chiefly of the neck, probably induced in the first instance by teething, by one or more of the above irritations, or by an exanthem, especially by measles; thus every instance of an enlarged cervical gland is not, of necessity, strumous. The characteristics of the scrofulous enlargement are its very chronic character, its continuance long after the causation has ceased, its spread from gland to gland, and the tendency of the glands to

attain considerable size and to be the seats of protracted suppuration.

(4) Most chronic joint-affections, arising between the ages of a few months and eighteen years, are scrofulous, though they may originate (as some believe) in slight traumatism. The affection may commence in the synovial membrane, in the epiphysis, or in the epiphysial junction; in the last two conditions, the hyperæmia of rapid growth affording the primary irritation.

(5) Chronic carious affections of the bones occurring during early life are very generally strumous, absence of syphilis being verified. Spongy bones, as the bodies of vertebræ, the small bones of the carpus and tarsus, the epiphyses of long bones, are peculiarly prone to such affection; the hard cortex of long bones is less often attacked. A peculiar enlargement or distension from within of one or more phalanges bears the name of dactylitis; it is generally strumous, sometimes syphilitic. Rachitis is probably a scrofulous affection in the large majority of instances.

The combination of scrofula and syphilis is by no means uncommon; the manifestations of the mixed diatheses are severe and obstinate. Some writers believe that scrofula is degenerated syphilis, an unproven hypothesis.

The *treatment* of the scrofulous diathesis (the treatment of the above manifestations falls each under its own heading) is first of all improved hygiene, including—residence in large, not over-filled rooms, in preference by the seaside or at a somewhat high elevation on a dry gravelly soil, good ventilation, plenty of light and outdoor exercise. The diet must be regulated according to the age of the subject, and for that age must be of the most light and wholesome description. In the refined delicate forms, fatty matters should especially be pressed; ale or stout also may be given; they are less valuable, sometimes inadmissible, in the other form.

In the administration of drugs a similar distinction is desirable. The former kind of struma indicates cod-liver oil, maltine, iron—what may be called the blood-making tonics; the latter quinine or other bitters, mineral acids (nitro-hydrochloric), iodide of potassium; if iron be employed it should be given as the iodide. Alkalies, when the breath is sour, are often valuable. In this form of the diathesis, an occasional purge and alterative are essential to the treatment, especially when phlyctenular ophthalmia or the other above-named eye-affections are present, while the breath has an evil odour.

RICHARD BARWELL.

SCROTAL ELEPHANTIASIS.—The general subject of elephantiasis having been fully discussed elsewhere (*see* ELEPHANTIASIS ARABUM), it only remains here to consider the disease as specially affecting the scrotum, and to describe the measures which have been adopted for the cure of scrotal tumours of this nature.

Several varieties of the disease, as affecting the scrotum, are met with in India and other places where this malady is rife. They may be included in the following categories:—

1. Solid hypertrophies of the external genitals. These may be subdivided into:

(a) Simple scrotal elephantiasis. In most cases both penis and scrotum are implicated, but in some cases (i.) the skin of the penis and the prepuce are mainly involved, the scrotum being less affected; and in others (ii.) the scrotum is the principal or sole seat of disease. Under this head also come (iii.) labial tumours in the female. The labia majora are the most common seat of the disease, but the prepuce of the clitoris and the labia minora are also sometimes thickened. In rare cases, the tumour is principally situated in these latter parts.

(b) Complicated scrotal elephantiasis. The complication may consist of—(i.) Abscesses and ulcers; (ii.) stricture of the urethra; fistulæ, urethral, perineal, and anal; (iii.) large hydroceles and hæmatoceles; (iv.) hernia. These local complications materially affect the question of operation. (v.) The tumour may be in a state of acute hyperæmia, with accompanying fever, or (vi.) there may exist diseased conditions of the spleen, liver, kidneys, bowels, or adjoining lymphatic glands, or some constitutional disturbance or cachexy. These general complications also raise a doubt as to the propriety of resorting to operation.

2. Condylomatous growths simulating elephantiasis—met with both in male and female subjects.

3. Warty growths implicating the prepuce, penis, or scrotum, that have attained such a size as to constitute a tumour, or associated with some elephantoid thickening, also met with both in males and females.

4. Serpiginous ulcerations, consequent on chancroid, and usually accompanied by some degree of elephantiasis.

5. Lymph-scrotum, consisting mainly or wholly of dilated lymphatic vessels, exuding spontaneously or on puncture a clear or milky fluid. The penis often remains healthy in this variety. Filarie are found

in this class of cases, but in none of the others. This form of disease is rarely, if ever, met with in the female.

It may be laid down, as a result of wide experience, that medicinal appliances are of little or no service in any of these forms of disease. A certain amount of relief may be obtained by recumbency, elastic bandages, and the local and general use of absorbents, more especially preparations of iodine; but, though the size of the tumour can be reduced by such agencies, the disease cannot be cured, and progressive enlargement will be found to proceed by means of those periodical attacks of fever, accompanied by local congestion and exudation, which characterise the development of the disease. It has also been established by a very large experience in India, China, and elsewhere, that by means of operation the local disease can be removed and the periodic fever which is associated with it cut short; and this without sacrifice of the essential organs of generation, or, in the great majority of cases, any risk of recurrence.

The questions which demand consideration here, therefore, are (1) in what circumstances is recourse to operation justifiable or desirable; and (2) what is the most approved and successful method of operating.

The inducements to remove the diseased parts by operation are these:—(a) The deformity and inconvenience caused by the growth, especially when it has attained a large size; (b) the sexual disability which it entails; (c) the discomfort caused by the periodical recurrence of fever; (d) the impairment of general health which results from these repeated attacks of pyrexia, which are often of severe character, and from the visceral disturbances, functional and structural, which are apt to be associated with a long-standing and progressive elephantiasis, and which undoubtedly tend to shorten life.

The earlier the tumour is removed, when it has once been fairly developed, the better, because the removal of a mass of moderate size, in a comparatively young subject, is a much less risky proceeding than the amputation of a large tumour in an old subject. Besides, the constitution and vitality of the subject are conserved by cutting short the fever, and preventing the development of visceral disturbance or decay.

The *contra-indications* of operation are:

a. *Old age.*—In the aged, sexual disablement is not a matter of much consequence, and if the tumour has, as often happens, become stationary in its growth, and the concomitant fever ceases to occur

or becomes less frequent and severe, operative interference, which is always more hazardous in the old, should be considered with more hesitation and caution.

b. Ill-health and visceral disease—more especially of heart, kidneys, or intestines. A weak or damaged heart, albuminuria, and chronic diarrhœa or dysentery, are prohibitive of operation. Cachexia and anæmia, however caused, also constitute serious objections to operating, and diabetes is absolutely prohibitory. Recent and acute enlargements of spleen and liver are likewise prohibitive, but chronic enlargement of either organ, if not accompanied with manifest impairment of health, is not a bar to removal by the knife.

c. Complications.—Reverting to the list of these given above—(i.) If the abscess be acute, it should be treated and cured before operation is resorted to; if chronic, or dependent on hæmatocele or diseased tunics, it may safely be removed along with the tumour. If the ulcer be small, and due to local irritation, or preceding abscess, operation need not be delayed. If large and due to general ill-health or extensive sloughing, caution and delay are advisable. (ii.) A stricture should be fully dilated before the operation is resorted to, because there is often difficulty in passing urine for a few days, and the use of a catheter is by no means an easy and safe matter unless the urethra is of normal size. Fistulæ should, if possible, be cured by dilatation of the urethra or by free incision, accompanied, if necessary, by urethral dilatation; and, if they cannot be closed, operation should be declined. (iii.) Very large hydroceles and hæmatoceles enhance the risk of the operation, but are not a bar to it. If the patient is very old, the propriety of interference is more than doubtful; but in young and middle-aged subjects operation is advisable, and both diseases can be radically cured by the same procedure. (iv.) The existence of herniæ imports a very serious risk to life, and the simultaneous performance of an operation for the removal of the tumour and cure of the rupture has been proved, by experience, to be a very perilous practice. (v.) Operation should never be resorted to when the tumour is in a state of excitement, or while any febrile constitutional disturbance exists. Large size does not constitute so strong an objection to operation as some of the other considerations which have been adduced; for though it is true, generally, that the danger of removal is directly proportionate to the bulk of the mass, still, under improved methods of

operating, the risks depending on size have been greatly reduced, and experience has proved that immense tumours of this description, weighing, after removal, from 100 to 120 lbs., may be easily and successfully amputated, the period of convalescence and ultimate result being much the same as in the case of smaller masses.

The removal of scrotal elephantiasis has been practised in India since the beginning of the present century, and, at the present time, operations for this purpose are unhesitatingly performed in all countries and places where the disease is met with. The mortality in uncomplicated cases is inconsiderable, and the relief conferred complete and permanent. At first, the operation partook of the character of an amputation rather than a dissection. A clean sweep was made of the whole mass, including the genitals, at the level of the pubes, the vessels being tied as rapidly as possible, and the wound allowed to heal by granulation. Some surgeons transfixed the base of the tumour with a long catlin, and cut flaps from each side of its neck.

Rapidity of execution was considered to be the main point, for the double purpose of saving suffering and blood. Gradually, attempts were made to save the sexual organs. The penis was dissected out, and in small tumours the testes, when they appeared to be healthy; but, when the tumour was large and the testes diseased, no attempt was made to isolate and preserve them. The use of anæsthetics and of appliances for preventing hæmorrhage has allowed greater deliberation to be practised, and it is now very seldom necessary to sacrifice the testes, either on account of the size of the tumour or of disease of those organs. A curious attempt was made in the years 1836–39 by Dr. Esdale, of the Indian Medical Service, to induce anæsthesia by means of mesmerism, and a hospital was organised in Calcutta for the purpose of carrying out his experiments. The annals of this institution are exceedingly interesting, and appear to establish the fact that operations can be painlessly performed on mesmerised subjects. The process of mesmerising was, however, tedious and uncertain, and the introduction of chloroform rendered further experiment unnecessary.

The principles in accordance with which the operation is performed, in the present day, are as follows:—

1. To empty the tumour as completely as possible of blood.

2. To prevent bleeding during the operation.

3. To remove every scrap of diseased tissue and of tissue likely to become diseased.

4. To preserve the essential organs of generation.

5. To secure the testes in proper position by catgut-stitching.

6. To prevent putrefaction in the wound.

A few observations on each of these heads will suffice to describe the steps of the operation.

1. Elevation and elastic bandaging are the measures employed for anæmiating the tumour, and they are perfectly competent to do so. Ten to twenty minutes, according to the size of the mass, are sufficient for the purpose.

2. To prevent bleeding during the operation, an elastic cord should be tightly applied round the root of the tumour before the removal of the bandage, and secured in its position by being attached by tapes to a waist-belt. An easier and equally efficient plan is to take an elastic cord about three feet long, pass the centre of it round the loins, bring the ends over the brim of the pelvis, cross them twice over opposite sides of the neck of the tumour, and, finally, bring these together below the navel; the neck of the tumour will thus be tightly embraced by two turns of the cord on each side, crossing each other on the pubes and just in front of the anus.

3. Experience has proved that if any portion of the diseased tissue be left behind, recurrence is almost certain to take place. Even although the prepuce appears to be healthy, it should be removed close to the corona glandis; and as thickening is peculiarly apt to commence in the raphe of the perineum, that part should in most cases be freely removed by a V-shaped incision up to the verge of the anus. If any attempt is made to cover the penis or testes with flaps, these should be taken from the skin of the abdomen or thighs, and not from the neck of the tumour; but a satisfactory result can be secured in all cases without resort to flaps, which are prone to slough or suppurate and to initiate septic disturbance of the wound and constitution.

4. The first step of the actual operation consists in decorticating the penis. A director is passed into the preputial cavity as far as the reflexion of its lining membrane on to the corona glandis, and, by means of a strong bistoury, the prepuce is slit open by transfixion and cutting upwards. An incision is made from the root of the penis on its dorsum to meet and complete this cut. The penis is then freed by finger and

knife, the mucous membrane of the prepuce being carefully detached at the line of its reflexion. The isolation of the penis is completed as far as its suspensory ligament, which should not be injured. A vertical incision is now made from the pubes to the fundus of the tumour, over one cord and testis. By successive bold strokes these are exposed, and then dissected out by fingers and knife, and subsequently held out of the way by an assistant. The other testis is similarly dealt with. The three vertical incisions are then connected at their pubic terminations by two transverse cuts, which must be beyond the limit of the diseased tissue. A circular or oval incision is now made round the rest of the circumference of the neck of the tumour, and by rapid strokes the whole mass is removed. Vessels are now looked for. The largest will be found in the centre of the perineum and on each side of the pubes. By gradually loosening the cord, others will be observed to spring. All bleeding points should be carefully secured, and as many as thirty to forty ligatures may be required. The parts may now be trimmed if, in the hurry of operation, any diseased tissue has been left behind; and if the tunics are redundant or thickened, as much of them should be carefully dissected off as can be done without endangering the vitality of the testes.

5. The testes may now be stitched together by means of prepared catgut, and fastened in proper position by a few tacks of the same material. Depressions or pockets can be very easily made for their reception, by separating the deep layer of the superficial perineal fascia from the subjacent fat and areolar tissue. The skin can then be drawn over them from each side to a considerable extent, by means of a continuous catgut suture.

6. The prevention of putrefaction in an extensive wound, from which there is necessarily a very profuse discharge, situated in such close proximity to the urethral and anal orifices, and to which it is difficult to maintain dressings in close contact, is by no means an easy task.

The use of the spray during operation, or of thorough irrigation with carbolic or sublimate lotion immediately after it, and the dusting of the wound with iodoform, followed by the careful application of antiseptic dressings, suffice in most cases to maintain asepsis and to prevent suppuration. The plan of dressing employed by the writer is—(1) The application to the raw surface of boracic ointment spread on thin gauze; (2) placing outside of this

a piece of boracic lint sufficient to overlap the whole wound and a margin of skin beyond; (3) outside this are applied folds of carbolic gauze, which extend beyond the margins of the wound on to the pubes and thighs; (4) a sheet of waterproof or oiled paper is spread over the dressings, and the whole secured by careful bandaging. The dressings are changed daily for the first ten days or so, while the discharge is profuse and the wound large; then every second or third day, as the wound contracts and the exudation from it diminishes.

The process of repair consists in the filling up of the wound-cavity with lymph, which glazes the wound and forms a medium of union between the testes, and between these and the surface of the perineum. When this lymph undergoes vascularisation and organisation, granulations form and cicatrization advances over the wound from the borders of the divided skin and preputial mucous membrane. The process of repair is tedious, occupying from six weeks to two months. Care must be taken to keep the penis free, as it is apt to be embedded in and retracted into the mass of granulation-tissue. Should such a result threaten, the granulations at its root may be broken down by the finger-nail, or divided by scissors if they have become firm. The ultimate result of the operation is, in the great majority of cases, satisfactory. Skin is dragged by the process of cicatrization from the thigh to form a seemly and useful substitute for the amputated scrotum, and the penis acquires a fresh covering of cicatricial epidermis. The sexual functions are restored, and both health and comfort re-established.

The operation above described is applicable to all the forms of elephantiasis which have been specified. If the skin of the penis is quite healthy, the scrotum may be removed alone by a circular incision round its neck, the testes being dissected out as the incision is deepened.

Labial tumours in the female are removed in accordance with the same principles. If very large, their base may be transfixed and tied with whipcord before amputation is commenced; but, in most cases, the prompt use of forcipressure forceps and sponge pressure suffice to prevent much loss of blood. The edges of the skin can be approximated or brought into contact by sutures, and the process of repair thus very materially shortened. K. McLEOD.

SCROTAL SWELLINGS, Diagnosis of.—In the examination of a scrotal swelling certain points must be kept clearly in

view, and this may be done by the surgeon asking himself the following questions:—Is this swelling a scrotal one proper, or does it extend into the inguinal canal or abdomen? Is it reducible or no, and, if reducible, is this real or only apparent? Is it fluid or solid? What are its relations to the testis, epididymis, or cord? Is any part of it translucent? Is it of the same consistence all over? What has been its rate of progress?

Scrotal swellings may be divided into: (a) those which occupy more or less of the inguinal region as well as the scrotum, and (b) those confined to the scrotum.

(a) The chief swellings here are:—1, scrotal hernia; 2, scrotal hernia with hydrocele; 3, infantile hydrocele; 4, congenital hydrocele (occasional); 5, hydrocele of cord (occasional); 6, incompletely descended testis; 7, large varicoceles (rare); 8, combined hydroceles—e.g. of the tunica vaginalis and of the cord (rare); 9, new-growths of the cord—e.g. lipomata, malignant (still rarer).

The method of handling any scrotal swelling is important. The left hand should take hold of the upper part or neck of the swelling, so as to steady the tumour; then any impulse on coughing can be felt for, and, at the same time, by a gentle downward squeezing movement, the rest of the swelling is pressed forward, and the scrotal tissues over it stretched, the fingers of the right hand being free to percuss, or otherwise examine into the nature of the swelling.

1. *Hernia* is one of the commonest scrotal swellings, being met with in children as well as later on in life. It may be known by the impulse at the neck, its ready reducibility (usually) on the patient's lying down, with slip or gurgle, the facility with which now the external ring and cord can be felt, its speedy descent when the patient stands up and coughs, and its lack of translucency. The thickened tissue felt in the scrotum after the return of the hernia is merely the sac, and not to be taken for anything more abnormal. If the hernia is irreducible, there will still be impulse, the feeling of coils of bowel or of granular omentum; and the irreducibility will be either temporary—due to neglect of the bowels or disordered digestion—or permanent, owing to repeated 'bowel attacks,' accompanied by slight colicky pains.

2. A hernia is frequently complicated with hydrocele (*see below*).

3. *Infantile Hydrocele*.—A sub-variety of the congenital, in which the fluid usually extends as far as the external abdominal

ring. Its smooth outline, transparency, and history are main points, while its irreducibility, and fluctuation without gurgling, distinguish it from hernia.

4. *Congenital Hydrocele*.—This is dull on percussion and translucent, the impulse is much less distinct; its reduction is generally perfectly easy when the patient is recumbent, but occasionally requires steady pressure; it is unaccompanied by any slip or gurgle unless a congenital hernia is also present.

5. *Hydrocele of the Cord*.—The fluid here is usually encysted, and is most frequently due to part of the processus funicularis remaining unobliterated, more rarely to some independent collection of fluid becoming encysted in the connective tissue of the cord. In the former case it will have been noticed from birth or from early childhood, in the latter it may date from an injury or strain. The swelling is often mistaken for a hernia, and a truss ordered. The following are the chief distinguishing points:—Usually oval in shape, the swelling is found to be limited above and below—i.e. when drawn down it has no neck; so, too, when drawn down, the impulse is less and less distinct. It cannot be completely and distinctly returned; though often tense, fluctuation can sometimes be made out; and by using a candle in a dark room and lifting the swelling up, translucency can usually be observed.

6. A *retained testis* often forms a swelling in the groin or upper part of the scrotum. Its shape, sensitiveness, mobility, and the empty scrotum are decisive. If retained in the inguinal region, a testis may be the seat of orchitis in recurrent crippling attacks. Some of these may be so acute that the swelling may simulate a strangulated hernia. Thus the attack may have come on after a strain, the patient persisting in his statement that he has always had a rupture which came down and went up again. The parts are exquisitely tender, and do not admit of handling; most acute pain may be present in the lower part of the belly, accompanied by nausea and constipation. On careful examination the scrotum is empty, no truss has ever fitted, the rupture has never been really reducible, and unless peritonitis be present, which is not common, the symptoms will be less urgent than those of strangulation; thus the vomiting will not be more than bilious, and flatus at least will be passed. If, after a few hours, treatment does not clear up the case, the diagnosis should be made certain by antiseptic exploration.

A testis retained in the inguinal region is liable, after repeated attacks of inflammation, to become the seat of malignant disease, and form a swelling in the groin and upper part of the scrotum. It will be known by the absence of the testis from the scrotum, the history of repeated inflammatory attacks, the steady increase in size, and painfulness of a swelling, which, chiefly solid, shows fluid at one or more spots. Lastly, the absence of a testis from the scrotum will prevent the surgeon from mistaking a retained testis, which is the site of acute epididymitis, for a bubo.

(b) The chief scrotal swellings proper are:—1, hydrocele (vaginal and encysted); 2, hæmatocele; 3, orchitis; 4, syphilitic testis; 5, epididymitis; 6, strumous testis; 7, new-growths; 8, varicocele.

1. A *vaginal hydrocele* is known by the absence of impulse, by its pyriform shape, fluctuation, and almost unvarying translucency. The testis is at the back, as shown by its sensitiveness and opacity. The increase has been slow, painless, and usually occurs in patients of middle or later life, though it is not uncommon in younger men after strain, injury, or in association with acute epididymitis.

An *encysted hydrocele* is recognised by its position to the outer side of, and rather anterior to the testis, its fluctuation, its shape—globose rather than pyriform—and much slower growth.

Swellings in which different hydroceles are combined—e.g. one of the tunica vaginalis and an encysted hydrocele—are met with, and may at first be difficult of diagnosis. A very common combination is hydrocele of the tunica vaginalis with scrotal hernia, and in the later stages of this combination, when the two swellings have come into close contact with each other, the diagnosis is a matter of some doubt at first, especially when the hernia is irreducible; but if attention is paid to the points already given, there will be no real difficulty.

2. A *hæmatocele* will be known, when at all recent, by its rapid onset after a blow or the tapping of a hydrocele; its condition, at first fluid, then more solid; its weight and want of translucency, and the position of the testicle at the back. A little later, especially if the patient get about, tenderness, redness, and œdema of the scrotum will point to an inflamed hæmatocele.

3. *Orchitis*, or inflammation of the testis itself, may be met with as an acute, sub-acute, or chronic affection. The acute is usually due to a blow; it is rare, though epididymitis (owing to some urethral cause)

is often called orchitis. Subacute orchitis may be due to a blow, the congestion which goes with ungratified and unrestrained sexual desires, or it may occur in the course of an attack of gout or mumps.

Chronic orchitis may be confused with an old hydrocele, hæmatocele, or some of the new-growths of the testis.

4. *Syphilitic orchitis* may present itself as a diffuse chronic inflammation of the testis two or three years after contagion, or later on as a gummatous affection, or the two may be combined. In the former, the swelling may reach the size of a large egg or small orange, the smooth heavy mass being devoid of testicular sensation; both testes may be affected. In the gummatous orchitis the enlargement is less, and the surface may be knotty. Both are insidious, both may be accompanied by subsequent wasting.

5. *Epididymitis*, in its acute and subacute forms, is one of the commonest of scrotal swellings. Its diagnosis will be aided by remembering that it is nearly always due to some urethral irritation, most frequently gonorrhœa. It shows itself as a rapidly forming swelling, acute and tender, at the outer and back part of the testis, from which at first it is separated by a distinct furrow. The swelling is flat-sided, the scrotal tissues red and a little œdematous, and some fluid is usually present in the tunica vaginalis. Nausea, chilliness, pyrexia accompany it, and probably some deep-seated pain has been noticed creeping along the inguinal region and cord, and the vas deferens is thickened and tender.

6. *Strumous testis*.—This obstinate affection usually begins as a painless insidious nodule in the head or tail of the epididymis, which tends ultimately to soften and gradually to perforate the scrotal tissues which have become adherent to it. The condition of other parts—the testis, vas deferens, and prostate—should be examined into for thickening and enlargement: the bladder for cystitis, and the kidney for any evidence of strumous pyelitis. A history of chronic inflammation of joints and glands, or of phthisis, will aid in the diagnosis.

7. *New-growths of testis*.—Where these are rapid in their growth and results, as in the case of encephaloid carcinoma or round-celled sarcoma, the diagnosis is not difficult; but where the progress is slow, where for some time the consistency keeps firm, the cord is not involved, and the patient's health remains good, as is often the case in a spindle-celled sarcoma, a chondro-sarcoma, or in the earlier stages of 'cystic disease

of the testis,' the diagnosis is by no means so easy, especially as the history of repeated slight injuries may suggest orchitis. See TESTIS, Diseases of the.

8. *Varicocele*.—This, one of the commonest of the affections in the scrotum, will be known by the soft, worm-like, bluish coils of enlarged veins around and along the cord, the relaxed scrotum, and the dropped testicle. When extending into the canal, a varicocele shows impulse when the patient coughs; but this is less distinct than in hernia, and alteration in the size of the swelling is only noticed when the patient has been on his feet or resting for some considerable time. It is not completely reducible, and if the surgeon, having got up all he can while the patient is lying down, place his finger over the external abdominal ring, and tell the patient to rise, the swelling gradually reappears below the finger.

W. H. A. JACOBSON.

SCROTUM, Injuries and Diseases of the.—*Contusions* may occur from falls on the edge of a chair, on a rail, pommel of saddle, &c, and owing to the looseness of the tissues, much extravasation may take place. This is often complicated with hæmatocele, but, if existing by itself, may be known by its superficial position and its crossing the scrotal raphe.

Treatment.—In severe cases absolute rest in bed should be enforced, and the scrotum be kept well raised by a suspensory bandage and a small firm pillow. A smart purge should be given, and its action gently kept up, and a cooling lotion—lead, or lead and opium—constantly applied. Where the coexistence of a hæmatocele is suspected, ice should be applied, but, except in strong and healthy subjects, it will be well to place a layer of lint next the skin. If the ice does not produce material relief within two hours, its use should be discontinued, and lotions, at first cold, then warm, gradually substituted, in order to prevent too rapid changes and sloughing of the scrotum.

If, later on, any thickening of the scrotum be left, it will be well to rub in oleate of mercury (5 p.c.), or to use counter-irritation by iodine.

Wounds.—These may be incised or lacerated, the results of falls, machinery accidents, or attempts at mutilation. In the case of a recent incised wound, after cleansing the parts and arresting hæmorrhage, it will be well, owing to the disturbing effect of the dartos, to draw the edges of the skin together with fine silk sutures, not passing them sufficiently deeply to

open up the cellular tissue. Before inserting these, the testicles, if protruding, must be carefully replaced, and the scrotal tissues relaxed by warmth. Cold lotions should be applied after insertion of the stitches, and the parts be kept well supported to prevent any bagging and strain on the stitches.

In lacerated wounds, stitches must be used with great caution and only in a recent case, a few points of fine silk being employed. Warm lotions, cotton-wool, and even support are here indicated, any stitches used being removed early, and punctures made on the appearance of œdema.

Œdema, Cellulitis, and Erysipelas of the Scrotum tend to run into and complicate each other. They occur chiefly in infants, especially weakly ones of lowly life, and in adults when depressed in health, ill-fed, and exposed to cold, and often in the subjects of visceral disease. The exciting cause is injury, or a much slighter matter, a patch of erythema, an abrasion, fistula, or even merely the trickling of urine. The chief dangers are, in the case of infants, peritonitis, if the processus funicularis be patent, and, at any time of life, sloughing and septicæmia. The scrotum and skin of the penis are, no doubt, well supplied with blood, but the vessels come from a considerable distance, are flexuous, and but ill-supported in the necessarily yielding cellular tissue of the parts, the meshes of this tissue being, furthermore, easily loaded with inflammatory products.

Cases of œdema, cellulitis, and erysipelas of the scrotum are to be carefully distinguished from those of extravasation of urine, which they closely simulate, by the absence of any previous urinary trouble, and by the facility with which a catheter can be passed. The history of a painful, localised swelling in the middle line—e.g. a perineal abscess observed before the appearance of the more general swelling—will also be absent. As long as the œdema or redness is slight, elevation of the parts, keeping them very dry and dusted with zinc and starch powder, will be sufficient, locally. A little later, multiple punctures will probably be required, and when the parts are not only tense and glossy but brawny, free incisions should be made into the cellular tissue. In making these, it should be remembered that the vitality of the parts is already seriously impaired, and that needless incisions will not only, by further interfering with the blood-supply, increase the liability to sloughing, but may also excite further diffuse inflammation. For this reason punctures will probably be sufficient

in children, and in adults it will not be needful to make more than two incisions on either side, one close to the raphè, about three inches long, carried well down into the lower and posterior part, and another somewhat shorter and external to this. The hæmorrhage will at first be free, but if any spurting vessels are twisted or ligatured, the oozing will be checked by pressure applied by a pad of lint and carbolic oil, over which iodoform and tannin have been dusted. Later on the carbolic oil may be replaced by saturated lotions of boracic acid, or an ointment of vaseline ʒj., ol. eucalypt. fʒj., iodof. ʒj.; prominent or weakly granulations being treated occasionally with lotions containing copper sulphate or nitric acid. The general treatment requires to be of a supporting kind.

Sloughing and Gangrene may follow on erysipelas of the scrotum, quite independently of any extravasation of urine, its most frequent cause. Other, but much rarer causes, are frostbite and the exhaustion of prolonged exanthemata. The changes in colour and temperature are quite unmistakable.

If there is no evidence of lesion requiring incisions, the part should be kept well wrapped up in cotton wool, in which a little powdered iodoform has been dusted, lint soaked in eucalyptus or carbolic acid oil, or poultices of yeast, charcoal, or chlorinated soda made use of, it being remembered that, as in other cases of gangrene, poultices, to do any good, must be changed frequently, and that this has the disadvantage of entailing frequent exposure. Later on, sloughs should be clipped away, and stimulating dressings, such as resin and tinct. benzoini co. made use of, and healing hastened by occasional applications of silver nitrate (gr. x.—fʒj.), and skin-grafting. The reparative power of the scrotum is well known; very large losses will be replaced, though the skin is now thinner, smoother, and less supple than before. Sloughing of the scrotum, and the milder inflammatory affections which may precede it—e.g. œdema and erysipelas—are usually accompanied by symptoms pointing to asthenia, and the treatment should be, from the first, supporting.

New-Growths in the Scrotum.—Of these epithelioma is the most common—‘chimney-sweep’s cancer’—though this disease is on the decline, owing, probably, to the use of machines in chimney-sweeping.

It usually begins as a small wart on, or as a pea-like swelling in, the skin, the disease starting in the latter case from the

irritation of a sebaceous gland or hair-follicle. In either case induration and ulceration follow sooner or later, though often insidiously, the ulceration presenting the characters of epithelioma elsewhere, viz. edges indurated, everted, and sinuous, the base of uneven depth, here greyish and sloughing, there prominent with unhealthy granulations. If left to itself, the ulceration may go so far as to expose and destroy the testicles, and involve the glands in the groin in large malignant ulcers.

Treatment.—This should be always early and free removal by the knife, aided, if need be, by caustics, such as zinc chloride and flour. As an aid to removal, a metal catheter may be kept in the urethra, and if the testicles are involved leave should be got, before the operation, to extirpate them if necessary. The inguinal glands, if merely enlarged, not densely hard, and if still movable, may be watched for a while. Where removal of the disease is not possible, the surgeon can only support the strength, relieve pain, and diminish fœtor.

A few other scrotal new-growths are very occasionally met with, viz. fibro-cystic, fatty, and fibrous; these last, though originating in the scrotum, often becoming attached to the epididymis or testis.

W. H. A. JACOBSON.

SCURVY. — This is a non-febrile general disorder due to defective diet, which is manifested by the ordinary symptoms of debility, by certain scattered lesions caused by effusion of blood or fibrin, and probably by degeneration of muscles and other soft parts. These conditions are always associated with, and doubtless result from, certain changes in the composition and physical properties of the blood. Though it has long ceased to be endemic, and may now be regarded as a rare affection, scurvy is still liable, as was proved during the siege of Paris in 1871, to break out under certain conditions, and to attack large masses of people.

The symptoms of scurvy in its latest attacks differed in no respects from those described by Lord Anson and by Bachstrom, Trotter, and others in the course of the last century, and the forms of the disease, still occasionally observed in crews of merchant vessels, differ only in degree from those formerly described as typical instances. It has been shown by most recorded observations that the essential cause of the scorbutic condition is abstinence, more or less prolonged, from certain succulent vegetables or fruits in a fresh state, or from their pre-

served juices. It is very evident, however, that scurvy, in its origin, course, and intensity, may be influenced to a considerable extent by other conditions. In a group of individuals deprived of vegetable elements of diet, some will remain free from any scorbutic taint, if not altogether, certainly for a long time, whilst others will present well-marked symptoms at an early period.

The conditions tending to resist an attack of scurvy are good general health, sufficient and proper nourishment, and fair hygienic surroundings. Opposite conditions to these, and such as cause general debility, degenerations of tissues, and alteration in the composition of the blood, favour the scorbutic attack, and often do this so markedly that some have been regarded not merely as predisposing, but also as essential causes of the disease. The most frequent of the many faulty conditions that favour an attack of scurvy in the absence of vegetables, is a generally poor and defective diet, especially a want of fresh meat. Conditions to which much importance has been attached, and which have certainly existed in many recorded instances of sea scurvy, are those of prolonged exposure to wet and cold, and of overcrowding in damp and confined quarters. Other very favourable conditions are chronic disease attended with exhausting discharges, and convalescence from some severe and acutely febrile affection. In instances of scurvy on board ship, the first, and often the sole members of the crew to become affected, are usually the subjects of dysentery, syphilis, or chronic rheumatism. Extremes of climate, both heat and cold, have been regarded as favouring conditions, and also prolonged absence of the sun's light. There can be no doubt that prolonged service in the tropics on board ship, under bad hygienic conditions and with indifferent food, predisposes to scurvy. The fatigue caused by extreme and prolonged muscular exertion has been regarded by many as another favourable condition; whilst, on the other hand, it was asserted by Lind that there is a special predisposition to scurvy in those who, through indolence or enforced confinement, take but very little exercise.

Notwithstanding the important part played by one or more of the foregoing conditions, in most instances of outbreaks of scurvy there seems to be no sufficient reason for regarding any of them as essential causes of the disease, or as capable of producing it, so long as the dietary includes proper vegetable food. It still remains to be proved, by well-observed and properly

tested instances, that scurvy can occur in the absence of such elements of food, or that an abundant supply of fresh meat, of milk, or of blood can, during a prolonged failure in the supply of fresh or preserved fruits or vegetables, or of the juices of succulent vegetables, protect against a scorbutic attack. The long-maintained freedom of the British and foreign navies, and the records of recent outbreaks on board ship, and in campaigns and sieges, help to prove the point argued by Dr. Parkes, in 1848, that 'true scurvy is caused by a deficient supply of the organic vegetable acids, or salts of fresh vegetables.'

The subject of scurvy is usually listless and depressed, and, from the beginning of the attack, complains of stiffness and of 'rheumatic' pains in the lower limbs. In most cases he suffers from pleurodynia, and also much pain, with a sense of constriction, in the region of the heart. The pulse is slow and feeble, and there is a decided tendency to syncope, which, in severe cases of scurvy, may be brought on readily and prove fatal in any attempt at active exertion or change of position on the part of the patient. The temperature in most instances is normal or slightly subnormal. Except in extreme and complicated cases, the action of the bowels is very sluggish. The urine is usually pale, clear, and abundant in the early stages; as the disease advances, it becomes scanty and high-coloured. There is very rarely any hæmaturia; in some few cases—according to Hayem in about one-fifth—there is transient albuminuria. Chemical examination of the urine indicates, according to Dr. Ralfe, a chemical alteration in the quality of the blood, consisting in a diminution of its alkalinity, due to an increase of acid salts and a withdrawal of alkaline salts—chiefly alkaline carbonates. The skin becomes dry, harsh, and wrinkled, and presents a characteristic pale yellow colour. The mucous membranes of the lips, eyelids, and hard palate are usually very anæmic. Occasionally, the skin of the lower lid and adjacent part of the cheek is puffy and of livid tint. The dorsal surfaces of the hands and feet sometimes become œdematous, but beyond these indications there is very rarely any dropsy. The characteristic signs of scurvy are the petechiæ and patches of ecchymoses presented by the skin, and the swelling of the gums. The skin of the lower limbs and, in late stages of severe cases, that of the upper limbs and front of the trunk is marked by numerous small petechial spots, varying in tint from pink

to deep red or deep brown, each of which is traversed by one of the hairs. In addition to these are larger, irregularly shaped, livid patches resembling small bruises. A common symptom of scurvy is extensive subconjunctival hæmorrhage.

In the subcutaneous cellular tissue, mostly in the lower limbs, are larger patches of diffused extravasation, which are manifested on the surface by pale blue mottling. More deeply situated under the deep fasciæ, and within the sheaths of muscles, are the so-called 'scorbutic indurations,' large masses of effused blood or blood-stained fibrin, which form hard, indistinctly circumscribed, and very tender swellings. These are most frequently observed at the back of the lower limb along the muscles of the calf and ham, and in the space between the tendo Achillis and the bones of the leg. In the former case the leg is flexed and cannot be fully extended, and movement at the knee is much restricted. The breath of a scorbutic patient is very foul, and in most cases, in the adult subject, the gums both in front of and behind the teeth will be found covered by soft fungous growths of a deep red colour, which are very vascular, and bleed readily when touched. These, like most of the other superficial lesions of scurvy, are probably due to local irritation. They are largest and most abundant about the necks of carious and dirty teeth, and in patients with sound and well-cleaned teeth are very often absent. It has been asserted that the gums of edentulous patients are never thus affected. The larger joints, the knees most frequently, are occasionally implicated in the manifestations of scurvy, becoming swollen and painful in consequence of an intra-articular effusion of a more or less blood-stained serous fluid. A frequent deep-seated lesion is the scorbutic node, formed by the deposit of a layer of organisable fibrin under the periosteum of a long bone, most frequently the tibia. Hemeralopia, as has been pointed out by Blane and Bryson, and also by some French naval surgeons, occasionally occurs in association with scurvy, and, in most of the instances, disappears simultaneously with the special scorbutic symptoms, after improvement of the diet. This affection, however, is very probably not a manifestation, but simply a concomitant of scurvy, and due to general poverty of diet rather than to absence of fresh vegetables.

In the advanced stages of severe scurvy, the superficial patches of ecchymosis in-

crease in number and extent, bullæ containing blood are formed on the surfaces of the limbs and trunk, and an increasing hæmorrhagic tendency is indicated by epistaxis and hæmatemesis, and by a discharge from the bowels of blood-stained stools. In many instances, the patient, sinking from cachexia and exhaustion, is attacked by fatal pericarditis or pneumonia.

In open surfaces, whether from recent wounds or ulceration, the influence of the scorbutic taint is shown by swelling and lividity of the margins of the sore, and by a fungous condition of the granulations. The discharge becomes very fetid, and consists either of blood-stained serous fluid or of pure blood. There is a constant tendency to bleeding from such surfaces, and the dressings are speedily stained by the dark red discharge. Any incision, however small, into the soft parts is followed by persistent oozing of blood. In these scorbutic wounds and ulcers there is usually a tendency rather to spreading than to healing. Recent cicatrices readily break down, and are replaced by open sores with fungating and spongy granulations. The seat of a recent bruise or wound, or of an ulcer, is, in a scorbutic subject, generally surrounded by a very broad zone of intense ecchymosis.

It has been recorded that in scurvy the bones become fragile, and liable to fracture on the application of slight force, and that the fragments show but little, if any, tendency to unite. In some cases of previous fracture in which the fragments had joined, there was a tendency, it has been stated, for the callus to become absorbed. Such results, however, were probably due to an association with scurvy of one or more of the ordinary causes of general debility, and, in some instances, to the action of mercury, which was formerly so freely and indiscriminately administered on board ship.

The proper treatment of scurvy is, as a rule, most satisfactory in its results, as all the symptoms, both local and general, will readily disappear on the supply of a good mixed diet, including abundance of fresh succulent fruits and green vegetables, and lime or lemon juice in the form of lemonade. W. JOHNSON SMITH.

SEBACEOUS CYSTS are among the most common varieties of simple tumours. They may occur in any region of the body except on the palms of the hands and soles of the feet, where sebaceous glands are absent. These latter open, as a rule, into

the hair-follicles, but, occasionally, they discharge their secretion directly upon the surface of the skin. The cysts may be either congenital or acquired, and may vary from the size of a pea to that of a large orange. The acquired variety appears at any age after puberty, but most frequently in middle life. These cysts are essentially tumours of and in the skin, and are most frequently seen where the hair is abundant and the sebaceous glands are numerous, as on the scalp and face, about the entrance to the various passages of the body—the anus, lips, nose, and ears—and on the back of the neck, and over the scapulæ. The skin of other parts may be the seat of these tumours. The writer has removed one, the size of a walnut, due to obstruction of the mouth of a follicle, from the skin of the abdominal wall of a young girl. The axilla, though covered with hair and sebaceous glands, is remarkably exempt. The contents of a cyst consist of inspissated sebaceous matter, which has a peculiarly offensive odour. Under the microscope, cholesterine crystals are visible, and, in some cases of congenital scalp-cysts, fine hairs are found as well as epidermal matter. The cyst-wall may be either thin and delicate, or hard and thick, and strengthened within by many epidermal layers. The inner surface of the cyst-wall is smooth, rough, or reticular; and the contents are of no constant colour, and vary from their usual character, as above described, to the pearly tumour of Virchow or to a honey-like consistence.

Sir James Paget has divided the acquired variety of sebaceous cyst into two classes—those in which a black spot can be found upon the surface of the tumour, indicating the orifice of an obstructed follicle; and those in which no such orifice can be detected (as frequently happens on examination of a scalp-cyst), and in which the cyst probably owes its existence to some hereditary taint, and should be classed under the head of new-formations.

A dermoid cyst of the scalp is a congenital sebaceous cyst, and is often seen near the outer angle of the orbit. It frequently involves the wall of the cranium, is usually visible at birth or a few days later, but may be noticed first only at the end of the second or third month of life. When placed in or near the median line, the diagnosis from meningocele is sometimes almost impossible. See MENINGOCELE. On the scalp the acquired variety occurs, as elsewhere, most frequently in middle life, is not seldom multiple, and in rare instances, by gradual increase in size during many

years and the consequent gradual absorption by pressure of surrounding parts, involves the cranial vault. The tumour or tumours are hard or tense and fluctuating; round, oval, or, if large, irregular in shape, and movable. When a sebaceous cyst inflames and ulcerates, the diagnosis from epithelioma is not always easy; the proliferating surface and offensive secretion being so like the latter disease. *See* SCALP, Injuries and Diseases of the.

A fatty tumour can be distinguished from one of these cysts—(1) by the locality in which it is situated; (2) by its lobulated outline; (3) by the fact that it lies beneath the skin, which can be pinched up over the tumour, and thus thrown into characteristic wrinkles. Spontaneous changes are apt to supervene in these tumours, without even a history of slight injury. If inflammation comes on in this way, much care must be taken in the management of the case.

Horns not infrequently originate in accumulated sebaceous secretion, and have at their base a collapsed sebaceous cyst.

Of the rare forms of sebaceous cyst may be mentioned those situated completely within the skull, within the abdominal cavity or in the palate, mouth, tongue, testicle, submaxillary region or neck. Those found in the abdomen, which contain hair, teeth, bone, cartilage, &c., can hardly be looked upon as within the scope of this article, though their contents are largely made up of sebaceous matter. *See* ABDOMINAL TUMOURS, Diagnosis of.

The cysts which occur beneath the deep fascia of the neck are interesting from being easily explained as due to the incomplete coalescence of the branchial arches, or the incomplete obliteration of one of the clefts, usually that between the second (hyoid) and third (thyro-hyoid) arches. They form oval or elongated tumours, which are soft and putty-like to the touch, and whose contents are easily displaceable on manipulation. There is, as a rule, one cyst, limited to either the right or left side of the neck, situated in the region of the hyoid bone, and which may or may not have been visible at birth. After its first appearance, it gradually increases in size to a certain point and then remains stationary. No pressure-symptoms are produced on the surrounding organs.

The deep submaxillary sebaceous cysts lie between the mandibular and hyoid arches, are placed laterally or in the mesial line, and are liable to be mistaken for ranula.

Treatment.—A sebaceous cyst can best be removed by dissection, or by transfixion and subsequent avulsion of the wall of the

sac. No part of the latter must be left, or troublesome after-consequences will ensue in the shape of continuous offensive discharge, an unclosed wound, and a permanent sinus. Operations upon these cysts should never be lightly undertaken, especially when there is more than one cyst or when the scalp is affected, and never except in persons in perfect health. If spontaneous inflammation occurs, an incision may be made into the cyst and other means be used to subdue the inflammation, but no attempt at removal is justifiable until all inflammatory action has disappeared. An ulcerated sebaceous cyst requires excision; so also does a horn of sebaceous material with a cyst at its base. The employment of caustics has been recommended (e.g. the liquor hydrargyri nitratis acidus), as it is said that erysipelas does not follow their use, and that patients are particularly susceptible to this disease after the more formal operation with the knife. Caustics are very tedious and painful in their action, and the surgeon had much better rely upon the means at his disposal for securing asepsis, than stake his reputation upon the prolonged application of an escharotic. In any doubtful case, the hair should be shaved for some distance around the tumour, the skin washed with soap, cleansed with ether, and every other device employed during and after the operation to keep the wound aseptic. The operation upon a congenital cyst of the scalp is more difficult than that upon the more common acquired variety, partly on account of its greater depth from the surface, and in part because of the thinness and delicacy of the cyst-wall and its adherence to the bone. It is to be remembered that a congenital cyst may completely perforate the skull and lie in contact with the duramater, so that great caution is necessary in deciding upon operative measures.

On the face these cysts are easily dealt with. The incision need not be long, or much disfigurement will result, and should be made in a direction depending upon the locality. The contents can then be squeezed out, the cyst-wall seized with forceps and dragged out forcibly, through even a very small opening. These face-cysts are most common in the skin of the side of the face, in front of the external ear.

The sebaceous cysts which lie beneath the deep cervical fascia can be divided, from the point of view of treatment, into two classes—(1) those which are very difficult to remove, since they run beneath the carotid sheath, and are often attached to the side of the pharynx and hyoid bone; (2) those

which do not present these difficulties during the operation of excision. In the former case, either the whole or the inner and deeper part of the branchial cleft is represented by the tumour. In the latter, we may suppose that the inner or deeper part of the cleft has been obliterated by the fusion of the branchial arches, whilst the outer part remains open through the cessation of the developmental processes, and subsequently becomes the *fons et origo* of a congenital sebaceous cyst, which is situated beneath the deep cervical fascia, and yet presents no great difficulties in removal.

Excision is the only treatment to be recommended for deep submaxillary sebaceous cysts. Any less radical measure, such as the use of a seton or setons, would almost certainly fail to obliterate the cyst, and would, if attempted, expose the life of the patient to considerable danger, on account of the facility and rapidity with which inflammation can spread to the larynx.

CHARLES A. BALLANCE.

SEBORRHŒA (*Synon.* Steatorrhœa; Dandriff).—*Definition.*—Seborrhœa is a disorder of the sebaceous glands, characterised by the deposit, on the surface of the skin, of oil or dried fatty matter.

Cause.—Frequently ill-health, chlorosis, exhausting diseases, phthisis, cancer, &c. In some cases the condition accompanies good health; occasionally it seems due to personal neglect.

Pathology.—A functional disturbance of the sebaceous glands, probably affecting both the quality and quantity of their secretion, which, instead of lubricating the surface in the normal way, is recognisable as an oily deposit or coating of dried fatty scales. It is commonest in situations where the skin is most abundantly supplied with glands—e.g. the scalp, face, nose, genitals. The deposit is found to consist of fatty matter and epidermal scales. The process may lead eventually to atrophy of the glands and hair-follicles.

Symptoms.—Two varieties are described, according to the nature of the deposit—(1) Seborrhœa oleosa, and (2) seborrhœa sicca.

Seborrhœa oleosa is rarely seen on any part but the face (nose, cheek, forehead), or bald scalp. The skin has a shiny, oily appearance, occasionally a dirty look from the admixture with the fatty deposit of carbon or dust of the atmosphere. The fat can be wiped off with a cloth, the surface is often reddish and cold, the orifices of the follicles being widely open or plugged with

comedones. This form of seborrhœa is rare, and is said to specially affect spirit-drinkers with fatty livers.

Seborrhœa Sicca.—The affection varies somewhat according to situation; hence are described—

(a) *Seborrhœa Capitis.*—This is by far the most common form: the sebaceous secretion dries on the surface of the scalp into thin, white, branny scales, known popularly as *dandriff*. These scales are constantly being removed by brushing, and fall about the shoulders; or they are thicker and yellowish in colour, caked upon the scalp or matting down the hair. Seborrhœa capitis generally affects the entire scalp, but it occasionally occurs in patches. On raising the scales, the skin beneath is seen to be of a characteristic leaden grey colour; more rarely it is of a pinkish or red colour, from the presence of some amount of inflammation. These latter cases are sometimes accompanied by burning or itching, with epidermal desquamation, and are probably more allied to eczema.

If the affection has been present for some time, there is more or less thinning of the hair, which may go on to permanent alopecia in consequence of the destruction and atrophy of the hair-follicles.

In infants, the scalp is frequently the seat of seborrhœa, which may be considered as a persistence of the physiological seborrhœa (*vernix caseosa*) of the newly born.

(b) *Seborrhœa Faciei.*—The forehead, nose, and cheeks are the parts usually attacked. These present a mask-like covering of greasy scales, in colour varying from a pale yellow to a dark olive-green, according to the complexion of the individual and the admixture of dirt. On peeling off the scales, little processes or plugs are seen on their under surfaces, corresponding to the orifices of the follicles. Some itching and hyperæmia may be present.

(c) *Seborrhœa Genitalium.*—The glands in this situation frequently present the seborrhœic condition. A white, soft, cheesy deposit is seen, in the male, on the glans penis and sulcus, in the female about the labia and clitoris; its decomposition may lead to irritation, resulting in balanitis in the male. In young females, the resulting inflammation may be of medico-legal interest.

(d) *Seborrhœa Corporis.*—Duhring describes, under this name, a variety of seborrhœa affecting the back between the shoulders, or the sternal and clavicular regions. It occurs in circular patches with pale reddish base, and grey or yellowish

scales; the patches frequently run together, and the appearance may closely simulate *tinea circinata*. The affection known in this country as *lichen marginatus* or *circinatus* is comparable.

Diagnosis from eczema, psoriasis, lupus erythematosus, *tinea*. On the face or scalp, seborrhœa may simulate eczema; the trivial itching, the absence of serous exudation and infiltration, in seborrhœa, are in marked contrast to the symptoms of eczema. In typical seborrhœa capitis, the pale anæmic scalp is quite different to the red scalp of eczema. On the scalp seborrhœa may simulate psoriasis, but the evenly spread greasy scales, with the pale skin beneath, are unlike the uneven, mortar-like scales of psoriasis, with its constantly accompanying inflamed condition of the skin beneath. In seborrhœa faciei the processes on the surfaces of the scales are very characteristic.

The name first suggested for lupus erythematosus—viz. seborrhœa congestiva—indicates the similarity which may exist between their objective symptoms. Reliance should be placed on the deeper redness or violaceous tint of lupus, its defined limit or line of demarcation, its infiltration and constant scarring, its tendency to affect the helix of the ears and to occur in subjects liable to chilblains.

Treatment.—When indicated, the hygienic surroundings should be improved; fresh air and moderate exercise should be ordered, especially in chlorotic females. Cod-liver oil and iron will be found the most useful internal remedies; the latter may be advantageously combined with arsenic. Calcium sulphide is recommended in doses, gr. $\frac{1}{10}$ — $\frac{1}{5}$, thrice daily.

Local treatment is most important, especially for seborrhœa capitis. Scales must first be removed; this is best done by thoroughly saturating the scalp with olive oil at night-time, a closely fitting flannel cap being worn for the night. In the morning, the head should be washed with solution of equal parts of soft soap and alcohol. This is rubbed over the scalp and a lather produced with flannel and hot water. After all soap is removed and the hair is dried, a little almond oil may be applied. Care should be taken to warn the patient that the washing will remove all loose hair. The washings should be repeated, as directed above, every two days until all scales are removed; longer intervals may be allowed if there is much irritation produced by the soft soap.

The after-treatment consists in the use of a stimulant application—e.g. \mathcal{R} Acidi car-

bolicli liq. f̄ss.; Ol. amygdalæ dulc. f̄ss.; Alcoholis f̄v.; Ol. bergamot q.s. To be sponged on the surface of the scalp night and morning; or the following pomade may be rubbed on the scalp with the fingers:— \mathcal{R} Pulv. hyd. oxid. rub. gr. v.; Adipis præp. ʒj.; Ol. bergamot q.s. It is not necessary to cut the hair.

The above treatment is applicable also to seborrhœa occurring on the non-hairy parts.

For seborrhœa of the genitals, washing with ordinary soap, combined with the after-application of an astringent alum wash, is sufficient. ALFRED SANGSTER.

SENILE GANGRENE. See GANGRENE.

SEPARATION OF EPIPHYSES.—

The traumatic forms only will be considered in this place: those arising from constitutional causes, or from disease in adjoining parts, having been dealt with under EPIPHYSES, Affections of.

It is manifest that this accident can only befall individuals in whom the epiphyses have not become joined to the shafts by bony union—that is to say, it can only occur up to about twenty-one years of age; in the majority of cases the patients are much younger. In one case, however, recorded by Bruns, the accident happened to a man in his twenty-fifth year. Apart from the cases occurring during childbirth, of which many instances are recorded by French authorities, undoubted cases occur in quite early childhood. Hamilton mentions a case at the shoulder-joint at thirteen months of age; Holmes one of the femur (lower) at eighteen months. It might be supposed that young children would be most liable to this form of injury; but statistics negative this conclusion, and show that it is most frequent between twelve and seventeen years of age. It seems reasonable to explain the immunity of younger children, by supposing that they are less exposed to the kind of accident which brings about this special form of injury. Owing to the difficulties of diagnosis, it is not improbable that many cases go unrecognised. The separations may be either simple or compound, single or multiple, partial or complete, and accompanied or not by other injuries, which may require independent treatment.

Causes.—Epiphysial separation may result from violence applied directly to the seat of injury, such as the passage of a cart-wheel over a limb near a joint; or from a

fall from a height, as from an upper storey window or into a ship's hold; or from the entanglement of a limb, in the spokes of a waggon-wheel or in moving machinery, exercising traction upon the joints; or from muscular violence, and occasionally from suddenly raising a child by its limbs. The injury has also been produced by traction on the limbs during childbirth. The most frequent cause is a fall from a height, and then, not seldom, several epiphyses may be implicated as well as other injuries inflicted. Thus, Mr. Hutchinson records the case of a sailor boy aged fourteen, who fell from the masthead, and sustained a fracture of his clavicle, and separation of the lower epiphysis of one humerus and of both epiphyses of the other. Mr. Holmes records a case of separation of the lower epiphysis of the femur and of the tibia, and probably also of both epiphyses of the fibula. The case is on record of a girl who pushed her toes under a door; in trying to withdraw them she separated the epiphysis from the shaft of the first phalanx of the great-toe. A boy, aged nine years, when playing at leap-frog, fell, his hand coming violently on the ground, and separated the lower epiphysis of the radius. Mr. Heath reported to the Clinical Society the case of a boy, aged fourteen, who, whilst raising his arm violently to bowl at cricket, felt something give way at his collar-bone. It was found that the epiphysis of the clavicle had become separated. The experimental production of this condition is most easily accomplished, at the ginglymoid joints, by an excess either of extension or of lateral movement; at the enarthrodial joints by an excess of abduction (Gurlt). Traumatic separation of the lower femoral epiphyses has been advocated in, and practised for, genu valgum. Although many cases have been treated in this manner, but very little subsequent interference with the growth of the limbs appears to have occurred, notwithstanding that separation of other epiphyses had been unintentionally produced at the same time.

Pathological Anatomy.—The points of chief pathological interest are—(1) does the injury occur exactly at the epiphysial line or does it involve some part of the shaft also? and (2) what are the effects of such an injury on the future growth of the bone? As regards the first point, there can now be no doubt that the separation may and does occur without any implication of the shaft: for such cases have been seen by competent authorities. In some of the compound cases, the extremity of the shaft has been found projecting from the wound, and has thus

placed this question beyond all dispute. What occurs in the case of a compound injury may also occur in a simple one. Nevertheless, the line of separation seldom runs accurately across the line of junction; the displaced epiphysis carries with it some portion of the diaphysis. 'The importance of the question,' says Mr. Holmes, 'about the precise position of the line of fracture is this: if the fracture be really a laceration of the epiphysial cartilage, this structure may be expected to be more or less altered by the inflammatory processes necessary for the cure of the injury. The ossifying tissue may consequently be permanently damaged, and loss of growth may result; on the other hand, if the injury be confined to the diaphysis, no such consequence seems likely to follow.' In some cases a considerable wedge of the diaphysis, together with its periosteum, may be included. The exact condition, as well as the subsequent course of events, is probably influenced by the age of the patient.

If the accident occurs in an adolescent, in whom growth and ossification are nearly completed, there is every probability that some portion of the diaphysis will be torn away; on the other hand, secondary consequences will be less marked; whereas, in a child, the greater amount of soft new bone along the line of junction and the greater general elasticity of the diaphysis render detachment of the epiphysis more easy, and fracture of the shaft less probable. *Per contra*, the repair of such an injury, even under favourable circumstances, must for a while, if not perhaps permanently, interfere with the growth of the bone. The extent of this interference will depend in some measure on the nature of the accident and on the amount of local injury; and when any arrested growth does follow, its effects will always be marked in proportion to the extent to which the bones have still to grow. The relative part played by the different epiphyses must, of course, be borne in mind in estimating the probable loss of growth, which may ensue in any given case: thus the humerus grows chiefly from its upper (in the proportion of two to one), the femur from its lower, epiphysis; and so, too, with the other long bones.

Separation of the epiphyses is by no means uncommon in early infancy, as the result of disease. The absolute integrity which may be re-established sufficiently shows that arrested growth is by no means a necessary sequel of separation, and it can hardly be doubted that many traumatic cases recover without ill-effects. It would

seem, therefore, that the results depend a little on whether, after accident, the parts can be put in thorough apposition. Probably, this depends on whether any and what portion of the shaft is displaced, together with the epiphysis, and to what extent the periosteum has been stripped up. Stripping up of the periosteum, to an extent not usually found in fractures, is quite a pathological feature of separation of the epiphysis, and is explainable by the greater thickness and vascularity of the periosteum, and by the intimate connection between epiphysis and periosteum which normally exists, and especially at the period of life when this form of accident is common. There is naturally great danger of synovitis, purulent or otherwise, with all the sequelæ which such a complication entails. From this cause suppuration not infrequently occurs, necrosis of either shaft or epiphysis being sometimes the result. Among the secondary pathological features, must also be mentioned atrophy of muscles and loss of power in the affected limb consequent on disuse. Mr. Bryant has recorded a case of separation of the lower extremity of the humerus, in which the displaced anterior border of the diaphysis so injured the brachial artery as to occlude it—recovery, however, taking place.

Symptoms and Diagnosis.—(General). The diagnosis of these injuries is often extremely difficult, and rests on a combination of symptoms rather than on any special one. A separation may reasonably be suspected when an injury, in a young person, partakes of the nature both of a dislocation and of a fracture. The crepitus in a separation of epiphysis is not always distinct as in fracture (it may be entirely absent); on the other hand, there is often unusual mobility for a dislocation. Unlike a dislocation, reduction is not accomplished suddenly and with the jerk peculiar to this injury, nor does the patient get the same comfort as after the reduction of an ordinary dislocation; moreover, the displacement recurs much more frequently and readily, where there is separation of the epiphysis than after a true dislocation has been reduced, and it is often a matter of difficulty to maintain the bones in coaptation. The amount and direction of the displacement, in any given case, will vary with those of the applied violence. In all cases of doubt, the symptoms should be contrasted with those usually found in a fracture near, and in dislocation of, the joint in question, and the correct diagnosis be arrived at by the method of exclusion. In

many cases of direct injury in the neighbourhood of joints, with open wounds, separations of the epiphysis may be found; the nature of such cases will, however, be obvious. Not improbably, the other injuries will absorb attention and control the treatment; the chief difficulties will be experienced in uncomplicated cases, the symptoms of which will naturally vary with the joint affected. Theoretically, the epiphyses of any of the long bones may be separated by injury; in actual practice, however, some bones are found to suffer more frequently than others. In 100 collected cases, Bruns gives the following ratios:—Humerus—upper epiphysis, 11, lower, 4; ulna—upper epiphysis, 1, lower, 2; radius—lower epiphysis, 25; femur—upper epiphysis, 2, lower, 28; tibia—upper epiphysis, 4, lower, 11; fibula—upper epiphysis, 3, lower, 4; metatarsus, 2; pelvis, 3.

Shoulder-joint (upper epiphysis of the humerus).—Generally there is swelling of the joint, which must almost necessarily be opened, but the amount will depend on the nature and severity of the injury. In all the recorded cases, the shaft of the humerus has been displaced forwards and upwards (the pectoral muscles assist in this) towards the coracoid process, where it can be seen and felt; it is, nevertheless, conceivable that violence applied to the front of the joint would displace the shaft in an opposite direction. The extremity of the bone is smaller and not so smooth as the normal head, nor so sharp and angular as in fracture. The head of the bone can be felt in the glenoid cavity; it can be made to move independently of the shaft, as the shaft can be rotated independently of the head. On making traction at the elbow, with the thumb pushing the shaft back to its normal position, crepitus will sometimes be felt; there is usually no difficulty in placing the elbow in contact with the side, differing in this respect from a dislocation. If the separation is complete there will be shortening, as in fracture of the surgical neck. The axis of the limb is directed downwards, outwards, and backwards; over and above this injury there may, of course, be others.

Elbow-joint (lower epiphysis of humerus).—Here, again, the symptoms and diagnosis may be complicated or not with swelling or external wound. The usual displacement is backwards. Given, an elbow-joint in a young subject having the appearance after an accident of a dislocation backwards, the triceps muscle arched, with

the sharp prominent extremity of the shaft of the humerus visible or tangible in front of the joint, separation of the epiphysis would be a justifiable diagnosis; if the bony prominences (the condyles of the humerus above, and the head of radius and the olecranon below) could be distinctly made out, their proper relative positions in an otherwise obscure case would be strongly confirmatory of this diagnosis. A dislocation after reduction would show less tendency to relapse than a separation, and its mode of reduction would be different: the elbow is flexed.

Wrist (lower epiphysis of the radius).—Mr. Holmes says that this injury ‘differs from Colles’ fracture in its symptoms, inasmuch as it does not present that obliquity of the hand which is a marked feature in many cases of the other injury.’ R. W. Smith gives a further means of distinguishing it by saying that the projection on the palmar aspect of the forearm is more marked than that on the dorsal, and that the sulcus which limits the dorsal tumour is horizontal instead of being oblique. In this, as in most other cases, the relative positions of bony prominences are of importance; in a dislocation of the hand, the styloid process assumes an abnormal position, but in separation from the shaft, the radial epiphysis follows the hand, and maintains its normal relative position. Cases are recorded in which the epiphysis of the ulna is displaced also; in other cases there has been fracture, low down, of the shaft of the ulna.

Hip-joint (upper epiphysis of the femur). The symptoms of this exceedingly rare injury can ‘in no respect be distinguished from the fracture within the capsule’ (Chelius); the latter, however, occurs almost solely in elderly persons. South records a case in a boy ten years of age, who fell out of a window on to his left hip. ‘The foot was slightly turned out, and scarcely any difference in the length of the two limbs could be observed; the hip could be readily moved in any direction without much pain, but, on bending the knee and rotating the limb outwards, a very distinct *dummy sensation* was felt;’ he made a good recovery. In another case, there was crepitus, eversion of the foot, and shortening to the extent of one inch (Post). The writer has seen a case which simulated hip-joint disease. De Morgan related the case of a young man age nineteen; while standing on some movable steps, they slipped from under him, and he was thrown four feet on to the flags below, striking the back of his hip with

great violence against the edge of some railings. The symptoms were eversion of foot, the outer surface of the trochanter looked backwards, there was one and a half inch real shortening (which was readily reduced, and as easily recurred). The trochanter, less prominent than on the opposite side, rotated with the shaft; there was obscure crepitus. He recovered with bony union.

Knee-joint (lower epiphysis of femur).—Separation of this epiphysis is much more common than the preceding one. It *may* occur laterally. Bryant records a displacement inwards, but the most common displacement is forwards. Speaking of this injury, Bryant says: ‘A displacement of the lower epiphysis of the femur may be mistaken for dislocation of the knee, and in young subjects, where this latter accident is supposed to have taken place, the surgeon should always consider the probability of the injury being of the former kind.’ Charles Bell records two cases. One was followed by suppuration in the knee-joint, with secondary perforation of soft parts by the femoral diaphysis; the other (caused by the limb becoming entangled in the spokes of a wheel) had to undergo amputation four years later on account of an aneurism caused by the displaced diaphysis. The knee-joint may escape being opened, as in a case recorded by Hawkins.

(Upper epiphysis of tibia).—In a case of double genu valgum, in which Delore had purposely detached the lower epiphyses of the femurs, the patient (a boy, aged seven) dying of measles on the twenty-first day, the epiphyses of the right tibia and of the left fibula were found ruptured. Traumatic cases are recorded with multiple injuries, where amputation has had to be practised in consequence of necrosis and of suppuration in the knee-joint (and ankle-joint also—Fischer).

Ankle-joint (lower epiphysis of tibia). These generally result from a high fall on to the soles of the feet, the momentum carrying the body forwards, so that the epiphyses and the feet are displaced backwards. Such cases will resemble a dislocation of the foot, from which it will be differentiated by the relative positions of the malleoli and feet remaining normal; the sharp edge of the lower extremity of the tibia will be perceptible in front.

As quite exceptional cases, may be mentioned—the ‘epiphysial ends of the pubes and ischium separated in the hip-joint in a case of fracture of the pelvis’ (Holmes); separation of the epiphysis of the great

trochanter of the femur (Key ; McCarthy) ; separation of the epiphysis of the two anterior iliac spines, along with that of the head of the femur (Bousseau) ; separation of anterior superior iliac spine from muscular action (Maunder) ; separation (with suppuration) of the epiphysis of the tuber ischii following a kick (the writer) ; separation of the symphysis pubis, from being run over (Holmes) ; separation of the epiphysis of the first phalanx of the great toe—the head of the metatarsal bone could be felt intact, with a rounded movable piece adherent to it, upon which the toe appeared to play' (Gascoyen).

Treatment.—It has been pointed out that cases of this injury vary very much among themselves, and thus no hard and fast line of treatment can be laid down. In cases of simple injury, the first care, and often the most difficult problem to solve, is to reduce the displacement and apply such a splint or bandage as will maintain the limb in its normal position. Plaster of Paris will be found very effectual ; it must be put on carefully, with a good layer of wadding next the skin—not too tight, yet firm enough to prevent re-displacement (by muscular action or the patient's movements)—and the whole limb must be kept at rest. If there be much heat and swelling, an ice-bag may be placed over the joint, and a gutta-percha or felt splint temporarily applied ; when these subside, the plaster bandage may then be put on. In compound cases plaster is seldom available, and even in many cases of simple displacement it may be more advantageous to use other forms of splinting.

Reduction of the displacement may be effected with or without anæsthetics. Like all injuries about joints, these cases should be examined from time to time, and passive movements commenced in order to guard against ankylosis. If gently applied, these movements may be commenced at the end of a week, according to circumstances and the joint affected. It is quite evident that, if any adhesions are about to form in a joint, they will be broken down at the end of a week with less pain and more readily than at the end of two weeks or longer. No hard-and-fast line of treatment can be laid down either for compound injuries or for cases of multiple injury. In some of the recorded cases, the extremity of the diaphysis has projected through the soft parts, and has had to be sawn off in order to effect reduction ; in other cases, gangrene has resulted from pressure of the displaced diaphysis on the vessels, and amputation has had to be resorted to. In some cases, owing

to injury of the periosteum and surrounding parts, suppuration has occurred, with exfoliation of the necrosed epiphysis. The adjoining joint is sometimes destroyed, and amputation becomes necessary.

Quite recently, Bruns of Tübingen has introduced and successfully carried out a new operation in two cases of old separation of the upper epiphysis of the humerus, 'which had not been recognised in the fresh condition, and which had healed with so much displacement that the utility of the arm was greatly impaired.' He deliberately cut down on the epiphyses, effected a separation of the adherent fragments with a small saw, removed a portion of the diaphysis, and then placed the fragments in their proper relative positions. Both operations were successful. Sublimate wool was the dressing used. Bruns also recommends this operation, with or without resection of the diaphysis, in recent cases of irreducible separation. It seems not unfair to anticipate that many cases which, formerly, would have been amputated, may in these days of antiseptic surgery be preserved ; and it is also probable that those surgeons who practise rigid antiseptics, will feel themselves justified in cutting down upon detached epiphyses and wiring them to the diaphyses, when other means have failed to keep the bones in juxtaposition.

Prognosis.—This will vary with the exact nature of the injury in different cases, and with the age of the patient. In young children, apart from other possible results, must always be borne in mind the probable impairment of growth in the length of the affected limb, whenever the affected epiphysis is much concerned with this growth. It is not possible to assert positively whether this impairment will occur ; the less the amount of local injury, the more complete the reduction and coaptation of the fragment, the less probable will this complication become, while opposite conditions will favour its occurrence. Nevertheless, so far as can be gathered from the hitherto published cases, this arrested growth occurs but seldom. It is true that the cases of arrested growth may not come under observation ; but, on the other hand, the original injury would certainly do so, and yet the total number of cases is relatively small when considered beside other forms of fracture. The next point to be considered is the effect on the joint itself. In some cases, ankylosis results even in simple injuries, while in compound injuries, purulent synovitis and periostitis

of the shaft may so complicate the accident that the patient's life is only saved at the expense of the limb. Reference to gangrene has already been made. The adoption of Bruns' method in cases of irreducible displacement will probably save many a limb alike from atrophy, from gangrene, and from amputation.

ROBERT WILLIAM PARKER.

SEPSIN was the name first given by Bergmann to an alkaloidal substance which he, with Schmiedeberg, succeeded in isolating from putrid yeast. This substance was obtained as yellowish acicular crystals of a sulphate salt (sulphate of sepsin); it gave all the reactions of an alkaloid like strychnia, &c., and when injected into the circulation in dogs produced the symptoms of *SAPRÆMIA*—i.e. rigors, fever, vomiting, restlessness, diarrhoea (often bloody), coma, and death; the post-mortem signs being, as a rule, multiple punctiform hæmorrhages, swelling of the spleen, and œdema of the lungs. Since the publication of this result, numerous observers have obtained similar poisonous alkaloidal substances from various putrid albuminous fluids and substances—e.g. maceration fluids, putrid pus, 'high' game, rotten cheese, hams, sausages, &c. The alkaloidal bodies of the same class, but which are obtained from corpses, have received the name of ptomaines, and this term is sometimes employed, with great advantage, to denote the whole number of putrefactive alkaloids. The claim of all these substances to be regarded as alkaloids rests on the double evidence of chemical test and physiological action.

As to their *chemical reactions*: they are separable from alkaline solutions; they combine like weak bases with the mineral acids; they give a yellow flocculent precipitate with phosphomolybdic acid; with iodine they give a brownish precipitate; with gold and platinic chloride they give respectively a yellow and orange precipitate; they are also thrown down as whitish precipitates by tannin and corrosive sublimate; while, to conclude, they are very frequently crystalline. Fused on platinum, they char and give off peculiar odours.

The ptomaines (using the word for all kinds of putrefactive alkaloids) obtained by Schmiedeberg, Brieger, and others from various putrid substances, meat, fish, &c., by a modification of the Stas-Otto process for extracting alkaloids, may be enumerated as follows:—

(1) Those possessing physiologically active properties—

Cholin.—A derivative of lecithin. Hence found in 'bad' eggs. If oxidised, produces muscarin.

Muscarin, a very powerful poison found in putrid fish, and known for a long time as the poison of fungi.

Mydalein, most important as causing *pyrexia* in addition to the general symptoms of ptomainic poisoning about to be described.

A body resembling *atropin*, producing symptoms closely similar to atropin poisoning, including ophthalmoplegia externa. Found in putrid meat of various kinds.

Sepsin, already mentioned above.

Neurin, a powerful poison, found in putrid fish.

Ethylenediamine, a similar poison, one of the compound ammonias like trimethylamine, prepared from putrid fish.

A body similar to digitalin in its effects, and two others which cause profuse diarrhoea have been extracted from decomposing corpses.

(2) Those which do not exhibit active physiological properties—

These possess very little interest for the practical surgeon, and therefore it need only be mentioned that a series of inert bodies closely allied to those not described have been found in putrid liquids, and have been named by Brieger, neuridin, cadaverin, saprin, putrescin, gadinin, &c.

Clinical Import.—Poisonous alkaloids, of the kinds just described, have been discovered by Bocci and Bouchard to exist in normal urine and fæces, both in the lower animals and in man. The latter writer has made the reasonable assumption, that these bodies are constantly being formed in the process of digestion and as constantly excreted by the kidneys. Unfortunately, putrid discharges from surgical wounds have not as yet been examined for ptomaines, but of course similar bodies must be found, which by absorption may produce the symptoms of *SAPRÆMIA*, the so-called septic intoxication or poisoning.

Again, the fact of the existence of these substances is of extreme practical importance, in considering the symptoms of acute intestinal obstruction and other conditions in which retention of fæcal matter occurs. In these cases the symptoms—vomiting, salivation, headache, frequency and irregularity of the pulse, generally attributed to reflex irritation of the medulla oblongata through the vagus—may be due to direct poisoning of the same from absorption, by the bowel, of the alkaloidal bodies formed

during digestion. Confirmation of this view may be found in the fact that washing out the stomach considerably relieves the urgency of the symptoms. In connection with this point, it must be remembered that the alkaloidal ptomaines, just described, differ considerably in some points of pathological action. These points we will now briefly consider, as they thus come to have a practical bearing.

Pathological Action.—When absorbed into the blood, the most universal symptom and one common almost to all the substances mentioned above, is diarrhœa, usually due to excessive peristalsis and secretion of mucus, with active congestion of the mucous membrane of the bowel, leading sometimes to extravasation of blood. On the other hand, there is sometimes paralysis of the muscular wall of the gut, accompanied by a ‘paralytic’ secretion of intestinal fluid. Next to diarrhœa (or purging), vomiting, heralded by a rigor, is a very common symptom, the very frequent association of these two conditions leading one to suppose that they are the result of the action of the poison on the medulla oblongata. At the same time, the vaso-motor centre is irritated so as to lead to general vaso-motor spasm, or at any rate contraction of the arterioles, this being particularly the effect of muscarin and its allies, while vaso-motor dilatation (if not paralysis) is as equally characteristic of atropin, &c. The evidence obtained from the pupil is usually looked on as most important, and, as an index to suggest that the ingestion of a poison has occurred, it is doubtless useful. Most are like atropin—viz. mydriatic—i.e. they dilate the pupil. A few, however, cause contraction of the same. Other directions in which these poisons act are by way of excessive secretion, salivary, &c., like mydalein, or, on the other hand, like atropin they produce a total arrest of such secretion, so that the mouth becomes perfectly dry.

If the ptomaine is taken directly into the stomach, as happens sometimes in taking tinned meats, game pies, &c., the effects are very rapid and violent; the symptoms simulating those of acute irritant poisoning—viz. vomiting and purging, collapse, coma, and even death in four or five hours. The effects are, of course, exactly proportional to the dose absorbed.

Treatment.—This article is merely descriptive of the sepsin compounds. For the symptoms and treatment, &c., of cases poisoned with the same, see SAPRÆMIA.

VICTOR HORSLEY.

SEPTIC DISEASES, Classification and Etiology of.—It is a hazardous thing, at any time, to attempt to classify and arrange even diseases the pathology of which is fairly well ascertained, and still more dangerous, therefore, to propose any arrangement for such an obscure and complex series of maladies as those which are termed ‘septic.’ Some writers have endeavoured to avoid the difficulty by assuming the wide differences between one case and another to be a question of degree only, and not of kind; but, fortunately, experimental pathology has come forward and rescued surgical science from the error of regarding the septic diseases as merely phases of the same process, and from concealment of want of knowledge under the plausible verbiage of unification. In fact, the pathology of these diseases is now (theoretically) so clear, that we may say it will be soon much more difficult to find a case of septic disease than to refer it to this or that class, since the prophylaxis of antiseptic surgery is gradually stamping out every variety.

The term ‘septic disease’ is generally understood to include every disease which can be shown to arise from putrefaction or fermentation. Although it would be more strictly accurate to make it embrace all cases of acute specific disease, the popular acceptance of the term does not include the acute exanthemata, such as typhoid fever, &c., these being unscientifically regarded as a separate family with the appellation of ‘zymotic.’ In passing, it is fitting to say here that a contracted expression, ‘sepsis,’ is gradually being adopted, especially abroad, to signify much the same thing as our term ‘septic disease;’ especially since it is usually employed to denote the fact of the likelihood that a patient, the subject of an operation, &c., may be attacked by the same. But, to return, the term ‘septic disease’ includes the following *general* and *local* diseases:—

1. Sapræmia.
2. Septicæmia.
3. Pyæmia—

} central,	or	} embolic,
} peripheral,		} exanthematous.
4. Puerperal Fever.
5. Erysipelas.
6. Infective Cellulitis, including Poisoned Wounds.
7. Acute Spreading Traumatic Gangrene, including ‘Quarter Evil,’ ‘Cancrum Oris,’ &c.
8. Hospital Gangrene.
9. Malignant Pustule.

10. Acute Necrosis or Infectious Osteomyelitis.

11. Farcy or Glanders.

This heterogeneous list, which includes affections purely local and others absolutely general, will suffice to show how hopelessly inadequate any theory must be which regards such diverse effects as being due to one and the same cause only.

It becomes necessary now, in describing these diseases, to separate them on some sound basis. Such a basis can only be founded on an accurate conception of the pathology of each disease. Whatever the nature of the septic virus in any one of the above-mentioned maladies, it is clinically obvious that it acts either by rapidly and directly affecting the whole system, or else, indirectly, by causing local mischief from whence poisonous products are absorbed into the general circulation.

It is therefore most convenient, and scientific withal, to divide the septic diseases into two main clinical divisions—(A) *General* and (B) *Local*; this separation meaning that, in the first class, the whole system is primarily infected, and that local mischief follows; while in the second class local mischief is the first thing, and general systemic poisoning a consequence.

DIVISION A. — GENERAL DISEASES.—

1. *Sapræmia*—i.e. poisoning by an alkaloidal product (purely chemical and non-vital) of decomposition. See SAPRÆMIA; SEPSIN.

2. *Septicæmia*—i.e. general infection of the whole system by a rapidly-increasing poison, which is usually inoculated in very small quantities, such poison being probably a parasitic micro-organism. In this variety of septic infection there is no formation of secondary abscesses. See SEPTICÆMIA.

3. *Pyæmia* (including Umbilical Pyæmia of new-born infants, Farcy, &c.)—i.e. general infection of the whole system by a slowly-increasing poison, which is sometimes inoculated in very small quantities—probably, therefore, a parasitic micro-organism—and which always produces secondary abscesses. See PYÆMIA.

Pyæmia, as it is seen clinically, is divisible into two classes, which, for want of better terms, may be called 'peripheral' and 'central,' such expressions referring solely to the position of the secondary abscesses. The pathology of these two classes is also different; this, of course, accounting for the difference in position of the lesions. Thus, in the 'central' variety the primary wound is usually a large, septic, inflammatory focus, situated in the neigh-

bourhood of veins of considerable magnitude. As a necessary consequence, septic thrombosis in the veins occurs. The septic clot thus formed is greyish and friable; portions become detached, conveyed to the right side of the heart, hence to the lungs, and so to the systemic circulation through the left side of the heart. Weber showed, long ago, that poisonous emboli could find their way through the pulmonary capillaries and lodge in any part of the general systemic circulation—e.g. spleen, liver, kidneys, &c.; but the assumption that the so-called 'pyæmic infarct' is not a true infarct, as produced by inert emboli, but rather a centre of septic necrosis, is probably the more accurate view of these 'central' lesions; so that their causation is to be attributed to the immediate action of the pyæmic virus, and not to a primary embolism followed by secondary septic inflammatory mischief. Whatever we may regard as the mechanism at work in causing abscesses in the internal organs, the distinction between the two clinical varieties of pyæmia just described must be borne in mind—viz. that there is one kind in which the lesions (abscesses, &c.) are mainly central, and another in which they are peripheral—i.e. confined to the joints, bursæ, fasciæ, &c.

4. *Puerperal Fever*—a vague term which is commonly employed to denote that a patient, who has just been confined, is suffering from either sapræmia, septicæmia, or pyæmia. No further reference in detail will be made in this article to puerperal fever (as it is generally understood), since the condition of a puerperal woman is precisely that of any other kind of surgical liability to infection with one or other of the three septic diseases just mentioned, as a natural consequence where ordinary prophylactic antiseptic precautions have been neglected.

DIVISION B. — LOCAL DISEASES. —

5. *Erysipelas* is an acute specific disease, affecting secondarily the whole system, which follows the (primary) inoculation of a wound by a parasitic pathogenic micro-organism (*Micrococcus erysipelatosus*).

This definition applies solely to 'surgical erysipelas,' so called—i.e. the erysipelas which attacks an open wound—and in no way refers to so-called 'medical,' 'idiopathic,' 'facial' erysipelas, the pathology of which has not yet been completely investigated. The incubation-period of traumatic erysipelas is about twenty-four hours. The organism grows through the lymph-channels of the subcutaneous tissues, producing characteristic local and general

symptoms, for the description of which see ERYSIPELAS.

6. *Infective Cellulitis* (including Poisoned Wounds) is a purely local affection consisting in a spreading inflammation, possibly due to a parasitic micro-organism or, indirectly, to the poisonous action of some product of decomposition. The patient is, in addition, secondarily poisoned by the absorption of the inflammatory products. See CELLULITIS; POISONED WOUNDS.

7. *Acute Spreading Traumatic Gangrene, including Quarter Evil*, is an acute, specific, inflammatory process, terminating invariably in gangrene. It is due to the inoculation into the tissues (frequently already injured by traumatism), usually subcutaneously, of a specific poison, which has been proved to be a thick bacillus in the case of 'quarter evil;' and since a similar organism has been found in cases of acute spreading traumatic gangrene in man, it is possible that it (the virus) is always the same bacillus.

The disease known in cattle as 'quarter evil,' the 'charbon symptomatique' of French writers, and the Rauschbrand of the Germans, occurs rarely in England, but has been transmitted (by direct inoculation) to man. It consists in a spreading inflammatory area, the centre of which is gangrenous. The patient thus absorbs the poisonous products of the tissue-necrosis.

Acute traumatic gangrene is the 'gangrène foudroyante' of the French authors. The condition known as noma or cancrum oris is properly included in this class.

8. *Hospital Gangrene* is a rare local affection, consisting primarily in an inoculation of a wound by a poison generated in an ahygienic hospital, and which is probably a parasitic micro-organism (a micrococcus), with a primary effect of causing a steadily progressive necrosis of the wound surface, and a secondary effect in producing general septic poisoning of the system. For details of this affection, see HOSPITAL GANGRENE; but it must be here noted that allied to this condition (in which the wound becomes covered with a tenacious, adherent, grey and fibrinous slough) are those cases where a wound is covered with a diphtheritic pellicle; and, indeed, cases of sloughing membranous pharyngitis ought to be included under the same heading as cases of hospital gangrene. In every variety of the affection there is, of course, secondary general septic poisoning.

9. *Malignant Pustule*.—An acute specific disease due to the growth of a parasitic pathogenic micro-organism (*bacillus an-*

thraxis). When inoculated locally, it produces a carbuncle of peculiar character. When inhaled, it produces a general poisoning of the system known as 'charbon,' or 'wool-sorters' disease.' See MALIGNANT PUSTULE.

10. *Acute Necrosis or Infectious Osteomyelitis*.—An acute specific disease in which the periosteum and marrow of any bone (usually a long bone) becomes the seat of acute suppurative inflammation very soon after some injury (frequently trifling); such local inflammation being followed by the lighting up of 'central' pyæmic lesions in the lungs, heart, &c. The poison is probably a micrococcus.

11. *Farcy or Glanders*.—A variety of Pyæmia. GLANDERS is so regarded as a special septic disease that it is mentioned separately here, but it more properly falls under the heading PYÆMIA.

Before discussing the etiology of the diseases just mentioned, reference must be made here to a certain causal nexus which exists between some of the exanthemata and the condition of patients after surgical operations, &c. Setting aside cases of so-called rheumatism occurring after gonorrhœa, and which are nothing more than subacute pyæmia, we must briefly notice the following facts:—

1. That scarlet fever is particularly liable to attack children recently operated upon, especially in cases where an operation has been performed for stone in the bladder or cleft palate.

2. That scarlet fever is particularly liable to attack the puerperal woman.

3. That although scarlet fever and erysipelas do not infrequently attack a puerperal woman and run their specific course, yet occasionally it would seem that, although the poison of one of these diseases has certainly been inoculated into a puerperal patient, it has not developed in the specific manner, but as a variety of 'puerperal fever.'

1. The scarlet fever which thus attacks surgical patients is apparently the regular disease, ordinarily endemic in this country, since its mode of onset, symptomatology, &c., are very similar. There is one difference, however, to be noted—viz. that the 'surgical scarlet fever' is very rarely followed by kidney-mischief. The only question that can be raised is whether this condition is not really a form of septicæmia closely imitating scarlet fever; but a discussion of this point would lead us beyond the scope of this article, and we can only note the occurrence of the above-de-

scribed condition, as a point to be borne in mind by the operating surgeon. Without doubt, prophylaxis, in the way of preventing all possible means of transportation of the contagion, is the most important practical bearing of the facts here noted, but extra precaution may be taken in the way of observing the temperature for at least a week before operating.

2. Nothing need be said on the liability of the puerperal woman to contract the disease, since such a patient is in the condition of a person after a surgical operation.

3. With regard to the oft-suggested metamorphosis of diseases, such as scarlet fever and erysipelas, into puerperal fever, all that can be said here is, that although, experimentally, septic diseases can be modified under certain circumstances, there is no reason to suppose that one disease can be started by the virus of another; indeed, all carefully noted facts point in the opposite direction. The true explanation of the supposed metamorphosis is, perhaps, that the exanthem, when inoculated into the puerperal woman (and there is of course the greatest danger of transferring the virus of septic disease or scarlet fever to a puerperal patient), sometimes runs a modified course, the modified disease being mistaken for one or other of the varieties of puerperal sepsis.

We must now leave this general part of the subject—viz. classification—and briefly discuss the circumstances attendant on the causation and etiology of the septic diseases, so far as they bear on the descriptions of the different varieties arranged above.

In the first place, we will consider the etiology of sapræmia only, so far as it is connected with the other septic diseases. For a fuller account, see SAPRÆMIA.

It will be obvious, as has already been suggested in the 'definitions' of erysipelas, infective cellulitis, &c., that a large part of the patient's symptoms is due to the secondary action on the system of the inflammatory products resulting from the primary inoculation. These inflammatory products are of importance in two ways. Firstly, by giving rise to tension they cause further stagnation in the blood-vessels, and consequently general diminution in the circulation, thus producing the most favourable condition—viz. rest, for the growth of micro-organisms through the tissues; secondly, among the inflammatory products are the results of the katalytic decomposition of the (albuminous) tissues. Such decomposition-substances are very numerous (see SEPSIN; SCHIZOMYCETES) and of variable

importance. Those of them which alone concern us now are, the ptomaines of cadaveric decomposition, alkaloidal substances which being absorbed into the lymph-stream or blood-circulation give rise to chronic SAPRÆMIA.

To recapitulate, it is clear that in cases of septic disease where the local mischief is considerable, the effect on the patient will be twofold—viz. (a) effect of the specific virus; (b) effect of the inflammatory products in producing a secondary sapræmia. The existence of this second factor explains why, in such cases, early incision and amputation produce such marvellously rapid changes for the better in the general state of the patient—viz. by making a clean sweep of one source of poisoning.

Having thus cleared the ground by eliminating the principal source of complexity in this class of diseases, we may now briefly consider the action of the specific septic poisons, so far as they throw light on the etiology of the septic diseases. It is impossible, in referring to these specific poisons, to altogether avoid entering on the endless question of the nature of the contagion in these cases—i.e. whether it is a living parasitic micro-organism (sometimes absurdly called a disease-germ) or a chemical non-vital substance. As will be seen directly, the evidence, so far, is in favour of the specific virus (which spreads by multiplication) being a pathogenic micro-organism; and, granting this to be the case, we may conveniently abbreviate explanation of the possible modes of action of such an organism, by enumerating the following classification of the possible modes of action of such organisms, a classification suggested by the writer three years ago in a Report on Septic Organisms to the Local Government Board.

1. *Mechanical Mycosis* (mycosis signifying invasion of the system by a fungus), the condition in which the parasitic micro-organism causes some at least of its effects by mechanically plugging blood and lymph vessels.

2. *Katalytic Mycosis* (katalytic signifying a splitting up or decomposition), a term employed here to denote the action of the organisms on the tissues they attack, or the condition in which definite changes are produced in the tissues by the vital processes of the parasitic micro-organisms, divisible into classes (a), (b), and (c).

(a) Where the parasitic organism gradually causes death by absorbing and breaking up, for its own nutrition, the tissues of the host.

(b) Where the parasitic organism, by the katalytic action of its life-processes on the tissues of the host, causes the production of a poisonous ptomaine.

(c) Where the parasitic organism directly or indirectly, by the above-mentioned ptomaine (b), sets up an acute inflammation.

We will now see how far experimental pathology has succeeded in elucidating the conditions of septic disease, for the tedious method of clinical observation has, naturally, done little more than bring the subject into the hopeless confusion indicated at the beginning of this article.

The experimental investigation of the causation of human septic diseases—i.e. pyæmia, &c.—is exceedingly difficult, for animals differ so much among themselves, and more especially one class from another, that no one has yet succeeded in isolating the virus of human pyæmia and septicæmia by the means at present at our disposal—viz. cultivation and inoculation. The last disease, however, mentioned in the foregoing classification—viz. malignant pustule—has been thoroughly investigated, and, its causation being now fairly well understood, we will first describe the virus and its action on animals, as being a typical instance of the pathology of an infective disease.

In the first place, the virus of malignant pustule and woolsorters' disease is a micro-organism, the *bacillus anthracis* (see BACILLUS; SCHIZOMYCETES, &c.), which from its size and affinity for staining materials, &c., is readily recognised. This organism, when cultivated purely, kills most rodents (guinea-pigs especially) with certainty in about fifty to sixty hours, the quantity inoculated being extremely small (microscopic). The symptoms produced by its spreading through the tissues are scarcely marked during the first day, but the temperature gradually rises, the animal loses its appetite, becomes lethargic, and ultimately dies comatose. The macroscopic post-mortem appearances are those of death from asphyxia, together, frequently, with marked swelling of the spleen (hence the term splenic fever applied to the disease when it occurs in cattle). Microscopically, it is found that the blood-vessels are crammed with bacilli, in many places completely plugging the calibre of the vessel. Here, then, we obviously have our first variety of mycosis—viz. a mechanical mycosis, the actual mass of organisms forming a mechanical obstruction to the blood-circulation, and not only to the circulation merely, but, by being present in such numbers, they must inter-

fere considerably (from that point of view) with the normal metabolic relations existing between the blood-stream and the tissues nourished by the same. Now, the second mode of mycosis, the katalytic form, plays a greater part than the mechanical mode just described, so we must also consider the bacillus as possibly killing—(a) by destroying the tissues of the animal affected, in finding pabulum for the rapidly growing and multiplying organisms; (b) by producing a poisonous ptomaine by the action of the organisms in splitting up the fluids and tissues of the host. As yet we have little positive evidence bearing on this point, but attention is being directed to the question, and already it has been found that various putrefactive organisms growing in albuminous fluids form, by reason of their life-changes, poisonous ptomaines. These bodies are specially referred to in the article on SEPSIN.

We have mentioned above that the *bacillus anthracis* may act locally or generally, in the first instance producing the form of carbuncle called MALIGNANT PUSTULE, and, in the second, the general disease called wool-sorters' or splenic fever. This leads us to discuss the next point of importance—viz. the mode of entry of the poison into the body. This factor is of especial importance, of course, and particularly so in discussing the probable modes of inoculation in human septicæmia and pyæmia, and, further, since the splendid prophylaxis of antiseptic surgery rests upon a correct understanding of the theories concerning it.

If the *bacillus anthracis* or its spores (the latter, doubtless, being the most frequent condition) be inoculated into the subcutaneous tissues of a man by means of a small scratch, raw surface, &c., it grows in the tissues, exciting (see *Katalytic Mycosis* (c) above) a gangrenous inflammation of a characteristic aspect. See MALIGNANT PUSTULE. If, however, it or its spores be inhaled in dust (some of which is probably swallowed) it penetrates the mucous membrane possibly of the air-tubes or the thin epithelial lining of the alveoli, and so gains access to the general circulation. In some instances it distinctly appears to have entered *viâ* the alimentary canal, and particularly through Peyer's patches and the other lymphatic follicles. In applying these facts generally to septic diseases, we find that whether the local effects are most marked, or whether, on the other hand, that general symptoms are the characteristic features of the case, in both the most

usual portal through which the poison gains ingress into the system is the subcutaneous tissue. We may abbreviate what must be said on this point by presenting the following table or list of means of ingress, together with the septic diseases the poisons of which enter thereby:—

ENTRY BY—1. *Subcutaneous and General Connective Tissues*.—Septicæmia, pyæmia, so-called puerperal fever, erysipelas, infective cellulitis, acute spreading gangrene, hospital gangrene, malignant pustule or external anthrax.

2. *Respiratory Tract*.—Woolsorters' disease or internal anthrax, sapræmia, farcy (other pyæmiæ?).

3. *Alimentary Tract*.—Sapræmia, internal anthrax, pyæmia (notably *after* enteric disease—e.g. typhoid, &c.).

The next question bearing on this point is the difference in the interval of time occupied in the absorption of different poisons. Very scanty information is to be gained from the few experiments devised to solve this problem. Davaine showed that the virus of anthrax was absorbed in a much shorter time (about half an hour) than that of sheep-pox. There can be little doubt that most septic poisons are not absorbed in less than fifteen minutes to half an hour, and that energetic prophylaxis may successfully intervene before the expiration of that interval.

The poison having found entrance, a few lines must be devoted to tracing it in the system. We have seen that our type, the *bacillus anthracis*, in one case grows in the connective-tissue spaces (locally), and, in another, spreads through the blood. Now, in the next septic disease the pathology of which has at last been determined by experiment—viz. erysipelas—the virus, a micrococcus, grows through the lymphatic vessels in the subcutaneous tissue. In the local septic diseases terminating in gangrene, the organism simply spreads through the cell-spaces in the ground-substance of the connective tissue, sometimes apparently invading the corpuscles themselves. On the other hand, in the obscurer diseases, pyæmia and septicæmia, the poison soon enters the bloodstream, and is conveyed thence all over the body. It remains entirely an open question how far the poison in these cases causes mechanical mycosis, but it can readily be shown that it sets up local mischief where it lodges. Most septic poisons develop in those parts of the body where the circulation is least active; hence, foci of the disease are found in the capillary meshes of

the liver, spleen, lungs, the joints, &c. We may, in passing, draw attention to the fact that this agrees with what we know experimentally of the growth of micro-organisms in tissues, and so suggests that, in all septic diseases where the poison multiplies, it is a micro-organism.

It now remains to see how the poison leaves the body. Apparently, in most instances, this is effected by means of the kidneys. That these organs excrete ptomaines there is no doubt, and from the fact of their being very frequently the seat of active disease in septic cases, organisms being found in the Malpighian glomeruli, in the tubules, and urine, there is good reason to think they play an important part in getting rid of infective poisons. Perhaps most of the excreta contain the virus, but this matter requires further elucidation. As a practical point, for instance, it may be observed that the desquamating epidermis, after erysipelas, should be treated as infectious material until proved to be otherwise.

Hitherto we have considered the septic poisons without regard to the individual peculiarities of the subject they attack. Thus, to return to our type, the *bacillus anthracis*. This organism is able to attack and kill man, most rodents (excepting some kinds of rats), ungulates, young dogs, not old ones, and yet is powerless when inoculated into birds. If, however, the vitality of the resistant animal is depressed—if, for example, the temperature of birds be lowered by immersion in cold water—they then become susceptible to the disease. This fact illustrates an apparently simple law, the details of which, however, are by no means clear. Complexity is introduced here on account of the possibility that frequent contact with septic poisons may confer immunity. Though this is by no means established, and there are facts reported which contradict it (e.g. cases of post-mortem-room porters, &c., who contract fatal septicæmia, &c.), it must, nevertheless, be borne in mind in considering the circumstances which determine successfully the resistance of an individual to any form of septic disease.

The facts concerning immunity, so far as is definitely ascertained at the present time, are that (1) individual peculiarities in the composition of the blood and its relation to tissue-changes, (2) activity of the tissue-changes (metabolism), coupled with free access to fresh air (complete oxygenation), (3) previous attacks (possibly), are the most important determining factors; but further attention cannot be given here

to this point. See POISONED WOUNDS; SAPRÆMIA; SEPTICÆMIA.

In conclusion, we may fittingly close the illustration of the facts on which the classification of the septic diseases is based, by reasserting the fact that all such diseases can be grouped under the two headings of local and general; such grouping depending upon the nature of the primary effects which follow inoculation.

Treatment and Prognosis.—These vary with each disease, to which reference must be made, as also for description of special symptoms, this article being only an attempt to give a brief arrangement of the septic diseases according to the most modern views. The condition known as blood-ferment poisoning, often regarded as a form of septic disease, is not so, properly speaking, but as it is often confounded with SAPRÆMIA, it will be found described at the end of the article on that condition.

VICTOR HORSLEY.

SEPTICÆMIA is an expression which has, unfortunately, been used in so vague a manner as to make it difficult to understand what is really meant by it. It will be conceded, we believe, by most of those who have paid special attention to the subject of septic disease, that it is too late nowadays to discuss the etymology of the expression, or to introduce the possibly more correctly constructed term, sephthæmia. Septicæmia, possibly from being more euphonious than accurate, is now in general use, and therefore in the classification of the SEPTIC DISEASES, it is retained to denote that variety of septic diseases to which it is most usually applied. To repeat that description here, septicæmia is the name given to an acute (specific) infectious disease, the poison of which is usually inoculated in very small quantities, therefore multiplies in the system, and consequently is probably a micro-organism. Finally, no secondary foci of inflammation occur in the course of the disease. In fact, we have to do with a poisoning of the whole system, most of the symptoms perhaps being due to affection of the central nervous organs, a poisoning which, like that of one of the acute specific fevers, is unaccompanied by any complications, such as thrombosis, endocarditis, &c., which frequently are found in pyæmia.

The form in which the disease appears is variable; the difference between one case and another, however, being apparently only one of degree in the virulence of the poison. It is easy, moreover, to divide the

disease clinically into two main classes—namely, *acute* and *chronic*. Although, in describing the symptoms of these two forms, we must separate one from the other, it will be more convenient to discuss their etiology together for purposes of comparison. Finally, a word must be added here to protest against the popular use of the term septicæmia, to signify the condition described in this work as sapræmia, in which the poison is a simple chemical substance, whose effects in the same individual are solely proportionate to the dose. The indiscriminate application of the term septicæmia to both these very different affections has caused much useless discussion among the learned, and much confusion to students.

Etiology.—That a patient should be the subject of septicæmia apparently one thing alone is required—namely, the inoculation of the virus into the circulation. The general conditions, which regulate individual powers of resistance to septic disease, do not appear to apply with much force in the most virulent forms of septicæmia; but there is one fact which either shows that constitutional peculiarities modify somewhat the course of the malady, or else is indicative of the existence of a specific difference between the acute and chronic forms of the disease. We refer to the observation (frequently made by the old surgeons) that *acute* septicæmia more often attacks people apparently very healthy than bed-ridden patients, while, on the other hand, the latter class are more subject to suffer from *chronic* septicæmia.

Not proposing to waste space by discussing this point, we will pass on to the conditions surrounding the inoculation of the virus. Although, of course, it is highly probable that septicæmia in both forms may arise from absorption of the virus by the alimentary canal or respiratory tract, it appears to be very rarely caused in this way; and, as all the cases which throw light on the clinical history of the disease have been obtained from instances of inoculation into the connective tissues, and possibly also directly into the blood stream, it will be best to describe in detail this mode only of the entry of the poison into the system. 1. *The source of the virus*: this in the very large majority of cases has been some putrid substance (usually the corpse of some person recently dead of a septic disease); next, the disease often occurs as a result of operations performed without antiseptic precautions, in these instances almost always being introduced from with-

ut by dirty fingers or instruments, the possibility of its arising autochthonously being very slight. 2. *The dose*: this may be excessively small, practically invisible to the eye, for some of the most fulminating cases have followed a very slight needle-prick; it is this feature in the etiology of the disease which makes the nature of the (to say the very least of it indirect) virus very evident. 3. *The mode of introduction*: this has already been indirectly referred to, and, in brief, consists merely in a wound of the skin which opens the subcutaneous tissue. Punctured wounds are more often followed by infection than incised ones, for the reason that there is but little flow of blood to wash out the poison.

We now arrive at the debatable point whether the poison finds entrance at once into the blood, or indirectly and later by the lymph-stream. It would seem possible that either event may happen, and, if so, it suggests a part explanation why the incubation-period differs in the large majority of cases. *Vide infra*. As a rule, there seems to be no affection of the lymph-glands as a direct effect in uncomplicated cases; swelling and suppuration, when occurring in these structures, being evidently the result of local inflammatory poison inoculated at the same time as the special septicæmic virus. Although this fact is suggestive, we cannot conclude therefrom that the poison is always absorbed directly into the blood-circulation. The poison having gained access to the system, now occupies a certain period of time (the 'incubation' period) before the first symptom manifests itself. The determination, however, of this most important point is beset with many difficulties, since it must of necessity but very rarely happen that an *absolutely uncomplicated* case even of *acute* septicæmia can arise. In a few instances, however, a person, apparently in perfect health, has been inoculated with an excessively small quantity of infective material, and has subsequently developed acute septicæmia; in these cases the incubation-period has been found to be from six to eight hours.

It is only right to state here that some authors, including Gussenbauer, regard these cases of short incubation-period as instances of *acute sapræmia*, but, especially in the absence of any reliable work on the micro-organisms of human septic diseases, we consider that this view is completely negatived—(1) by the fact that the dose of a ptomaine necessary

to produce such a powerful effect would have to be very appreciable in quantity of the substance, and certainly not such as could be contained in a minute trace of pus on a needle; and (2) that when a ptomaine produces powerful effects, the incubation-period is usually a twentieth part of that in the case now under discussion. It is impossible, however, to decide accurately the incubation-interval in septicæmia until the virus of the disease has been isolated. Any attempt to form an estimate of the same period in chronic septicæmia, would be infinitely more hopeless, since that condition, so far as we know, is never uncomplicated, and the co-existence of sapræmia will mask the obscurer symptoms of septicæmia. We must, therefore, leave this question, and, after glancing at the mode of excretion of the poison, turn to the symptomatology of the disease. So far as is known (and that is very little), the poison is excreted in the urine, and organisms have been found to some extent in the kidney; if analogy is justifiable, it is possible that the renal tract excretes the poison of septicæmia, just as we know it does the virus of sapræmia.

Symptomatology.—The symptoms of septicæmia differ, in the acute and chronic forms of the disease, rather in degree than in kind, although quantitative differences may appear to be qualitative variations. In the acute form, the patient feels very depressed and ill at the end of the incubation-period; to this is very soon added severe headache, followed by vomiting, and then there frequently occurs a severe rigor, though this latter is not a perfectly constant feature. The temperature now will have risen to 104° or higher, and falls a little each morning of the illness, rising again in the afternoon or evening. For the first two days there is little else to note in the general state resulting from the specific poison, but, within the first twelve to twenty hours, the seat of inoculation will be violently inflamed and produce symptoms due to sapræmic changes or pain, &c. *See SAPRÆMIA*. By the end of forty-eight hours, however, delirium will have succeeded to the headache, and, still later, subsultus tendinum indicates the extent of poisoning which the nerve-centres are subjected to. Alternating with delirium is stupor, and, as the case approaches a fatal termination, this becomes coma—a stage from which the patient is never successfully roused. As might have been expected, the centres in the medulla oblongata gradually fail,

the *respiratory* movements becoming shallower and more frequent, while the *pulse* grows smaller, usually quick and irregular, indicating the gradual weakening of the cardiac centre. Provided no further complication co-exists, acute septicæmia causes death in from four to seven days, the temperature ordinarily falling very rapidly a few hours before death, often subnormally. In addition to the above constant symptoms, others frequently occur, which, however, are possibly due to sapræmic poisoning and not to the specific septicæmic virus. The most prominent of these is diarrhœa, which usually comes on about the second day, and as a rule is not bloody, as in sapræmia.

The effect of the poison on the kidneys is evidenced, in its turn, by a scanty secretion of albuminous urine, the albumin almost always appearing towards the end of the disease.

CHRONIC SEPTICÆMIA.—As will be understood from what has just been said, it is doubtful whether this disease is an uncomplicated condition. The incubation period alone is a matter of complete uncertainty, so that it is impossible to define the limits of the disease. Speaking generally, we may say that a patient, the subject of a wound infected with the septicæmic virus, shows at the commencement of the disease the same symptoms, only much less marked, as in the acute form. However, the disease in the chronic form preserves throughout a subacute progress. The temperature, although constantly above normal, does not rise so high, and the morning remissions of pyrexia are greater than in the former case. The most obvious pathological feature in chronic septicæmia is swelling of the spleen, this organ often becoming enormously enlarged. Swelling of the spleen occurs in every case of septicæmia, acute or chronic, but notice of it has been reserved until now, because it is more easily noted in the subacute form.

The frequency of swelling of the spleen in septic diseases is an extremely important fact, the interpretation of which, however, is proportionately as difficult. Suffice it to say, that the concurrence of leucocytosis, together with profound changes in the other constituents of the blood, is extremely suggestive in connection with the fact of splenic swelling. The other parenchymatous organs, the liver, &c., show marked degenerative changes, commencing as cloudy swellings. Rarer symptoms found are : rashes on the skin, lung-complications, and inflammatory affections of the serous

membranes. With regard to the skin-eruptions, there is no doubt that a scarlatina-form rash not infrequently appears in acute septicæmia, but (*see* SEPTIC DISEASES, Classification of) is not to be confounded with surgical scarlet fever. Much more rarely, papular and pustular eruptions occur, and still more rarely an urticariform rash. Lung-complications are, usually, bronchitis and pneumonia, and finally the serous membranes are invariably the seat of petechial extravasations of blood, their cavities being frequently filled with blood-stained serum, and more rarely with highly infective pus. These conditions give rise, of course, to the ordinary symptoms of pleurisy—empyema, pericardial effusion, &c. The other symptoms are the same as those of acute septicæmia, and, in comparison with the latter malady, chronic septicæmia runs a course of nearly treble duration, cases often lasting three to four weeks.

Pathological Anatomy.—The changes in the internal organs, in septicæmia, are naturally relatively very slight where the poison is so extremely infective and rapid in action. We have already indicated the changes in the principal viscera, and have only to add a few additional observations on these points. In the first place, the nerve-symptoms and mental derangement are found to be produced by extreme congestion of the pia mater ; similar congestion, and occasionally punctiform extravasation, being found in the deeper parts of the central nervous system. Moreover, the heart is occasionally the seat of ulcerative endocarditis, which gives rise, as usual, to secondary embolism.

Treatment.—It is of little use to point out here the absolute prophylactic value of antiseptic precautions in preventing the absorption of the septicæmic virus, since these are already referred to in the articles on ANTISEPTIC SURGERY and POISONED WOUNDS.

The direct treatment of acute septicæmia is most unsuccessful, which is natural enough when we consider that the virus has not yet been isolated. Proceeding on theoretical principles, we may, for the sake of classification, divide the treatment into local and general.

Local Treatment.—The first thing to do is undoubtedly to destroy what remains of the poison, and to prevent any further formation of the same at the point inoculated ; and this is best done by laying the wound freely open, irrigating it with 1 in 20 carbolic acid solution or chloride of zinc, 40 gr. to fʒj., &c., and then treating it with hot boracic fomentations and hot antiseptic baths.

General Treatment.—A vigorous attempt to attack the poison in the system should be made by administering large doses of quinine and salicylate of soda (20 gr. of the former and 60 to 70 gr. of the latter per diem). Warburg's tincture and antipyrin (the latter in 15-gr. doses until the pyrexia is reduced) are likely perhaps to be valuable. Useful adjuncts to the above antipyretic treatment are ice-packs and sponging, and the ice-cap. Special treatment of ordinary kind must be employed for the rarer complications noted above.

For diet, &c., general rules must be followed, and, as regards stimulation, the pulse is to be the sole guide to the administration of alcohol, ammonia, ether, &c.; stimulants only being given when heart-failure is distinctly marked, the depression which follows over-stimulation being particularly dangerous. See PULSE.

Prognosis.—Acute septicæmia is commonly regarded as necessarily fatal, unless vigorously treated within the first twenty to thirty hours of the disease, and even then the outlook is extremely serious.

Chronic or subacute septicæmia is a more manageable affection, but probably 50 per cent., if not more, of the cases die.

VICTOR HORSLEY.

SEPTUM NARIUM, Affections of the.—**DISPLACED SEPTUM.**—The displacement is generally the result of an injury such as a fall or blow upon the nose; but it may be due to a congenital defect in development. It may come on spontaneously, either about the second year, when it appears to depend upon an overgrowth of the cartilage at its junction with the vomer, similar to that which occurs at the epiphysial line in rickets, or else a little after puberty, a period at which there is normally a great increase in the growth of the septum. The extent and character of the displacement vary considerably. Thus, the whole septum, especially when the displacement is due to an injury, may be bent to one or other side, or dislocated from the maxillary crest, whilst there is generally, at the same time, some lateral deviation or depression of the lateral cartilages, or more rarely of the nasal bones. Again, the displacement may be limited to the line of junction of the septal cartilage with the vomer, the displaced part then forming a prominent ridge in that situation; or, again, the anterior portion of the septum may be dislocated from the anterior nasal spine, forming an unsightly red prominence just within the nostril. When the displacement is extreme, the septum may

come into contact with the outer wall of the nasal fossæ and even adhere to it, producing complete obstruction of the passage.

Symptoms and Diagnosis.—The patient generally complains of a feeling of stuffiness or obstruction in the nostril on the side towards which the septum is displaced, an alteration in the tone of the voice, and a chronic discharge from the nose. Less frequently he suffers from frontal headache, a feeling of giddiness, slight deafness, and still more rarely from epiphora, epistaxis, and even dropsy of the antrum, symptoms referable to the spread of the nasal catarrh to the frontal sinuses, nasal duct, &c., or to their obstruction by the displaced septum. The red prominence just inside the nostril and the external deformity, however, are, when present, perhaps the patient's chief annoyance. On looking into the nostrils, the displaced septum will at once be seen more or less completely blocking up one of the nasal chambers, whilst, on the opposite side, a corresponding depression will be discovered, and will at once serve to distinguish the affection from a polypus, an hypertrophied spongy bone or a septal growth, for which it has, however, before now been mistaken.

Treatment.—This will depend upon the nature of the case. Where the whole septum is displaced it should be forcibly straightened, and the lateral cartilages or bones, if also displaced, rectified at the same time. For this purpose, the writer's modification of Adams's forceps will be found convenient, as in their use the columna is not injured. In rectifying the bones great force has to be used, but the writer has hitherto seen no harm follow. Should the septum, as is occasionally the case, be very resilient, and resume its faulty position on removing the forceps, its resiliency must be destroyed either by well breaking up the cartilage with the forceps, or by making a stellar incision in it with a properly shaped knife. Whilst the replaced septum is undergoing consolidation in its improved position, some form of retentive apparatus should be used. Thus, for the first few days Adams's screw instrument may be worn, and subsequently for some days longer suitably formed plugs. The writer has of late substituted hollow vulcanite plugs for those formerly employed, so as to allow of nasal respiration being carried on during their use. For retaining the lateral cartilages in position, several contrivances have been invented. The writer uses for this purpose a mask accurately

fitting the face, as affording the best means of obtaining a fixed point from which to bring pressure to bear upon the nose. When the anterior portion only of the septum is dislocated from the nasal spine, a suitably shaped flap of mucous membrane should be dissected up from over it, and the projecting portion be shaved off.

TUMOURS OF THE SEPTUM.—Blood-tumours and abscess have been described in the article on the Nose. The other tumours that have occasionally been met with are myxomatous, cartilaginous, and osseous, and more rarely sarcomatous and epitheliomatous growths, whilst syphilitic gummata are far from uncommon. The *diagnosis* of these affections is easy if care be given. In blood-tumour, the history of an injury, and the presence of a rounded fluctuating swelling on both sides of the septum, unattended with signs of inflammation, should distinguish it from an abscess, in which there is inflammatory redness, pain and swelling, and often much œdema of the upper lip. Syphilitic gummata may also occur on both sides of the septum. They are at first hard, but softening usually soon sets in, and necrosis and perforation of the septum may result. Concomitant signs of syphilis, the history of their commencement, and the result of treatment, usually serve to distinguish them. Cartilaginous and osseous tumours may be known by their slow growth and excessive hardness, and may be distinguished from a deviated septum by the absence of a depression corresponding to the swelling in the opposite nostril. Sarcomatous and epitheliomatous growths may here, as elsewhere, be recognised by their rapid growth, involvement of surrounding parts, and the other characteristics of malignancy. The microscopical examination of a small portion snipped off the growth should clear up any doubt as to its nature.

The *treatment* of abscess is an early and sufficient incision, so placed as to favour drainage. For syphilitic gummata the usual syphilitic remedies must be employed. Cartilaginous and osseous tumours, if small, may be removed with small bone-scissors, or better with the small circular saw of the dental engine, taking care not to perforate the septum. When large, the growth must first be exposed by ROUGE'S OPERATION, or by one of the other methods of exposing the anterior openings of the nasal chambers described under NASAL POLYPUS; NASO-PHARYNGEAL GROWTHS.

ŒDEMA OF THE SEPTUM NARIUM.—This condition, which is usually limited to the

posterior part of the septum, has only been recognised since the introduction of posterior rhinoscopy, and would appear to be not very uncommon. It gives rise to symptoms of nasal obstruction similar to those produced by nasal polypi far back, or by hypertrophic nasal catarrh. On each side of the posterior border of the septum the mucous membrane appears swollen, forming two whitish, oval, cushion-like prominences, soft and elastic to the probe, projecting into, and more or less blocking up the choanæ, and contrasting strongly with the general red colour of the mucous membrane around. This appearance should at once distinguish œdema from polypus.

Treatment.—Puncture, or tearing away portions of the œdematous mucous membrane with forceps has been recommended; but the best results are obtained by the application of the post-nasal galvanocautery. When the œdema is associated, as it frequently is, with hypertrophic nasal or retro-nasal catarrh, these affections first call for treatment.

PERFORATION OF THE SEPTUM is generally due to the softening and breaking down of syphilitic gummata, and consequent death and separation of the underlying bone or cartilage. Less commonly it results from strumous ulceration or periostitis, or from the erosion of a lupous patch within the nostrils. It may also follow an injury, blood-tumour, or abscess of the septum. Workers of chrome are especially liable to perforation of the septum in consequence, it would appear, of the irritating and corrosive action of the fumes. The perforation in these cases occurs with great rapidity, and generally within a few days after exposure. It is usually preceded by congestion of the mucous membrane, attacks of epistaxis, and a profuse purulent discharge. The discharge, however, has no fetor, probably in consequence of the antiseptic action of the chrome, a fact which is of value in distinguishing this form of perforation from that due to syphilis. The limitation of the process and its amenability to simple remedies further aid the diagnosis. When the perforation, however caused, is small, it is frequently productive of a peculiar whistling sound during respiration, and when extensive may lead to the falling in of the bridge of the nose, though very large portions may sometimes be lost without this happening. Small perforations may be closed by plastic operation, or if this fails, the opening may be sufficiently enlarged to prevent the whistling.

W. J. WALSHAM.

SEQUESTRUM is a term used for dead bone, when it is quite loose and detached from the living. It is oftentimes used as a synonym for necrosis, but should be more properly employed only as above described. *See* NECROSIS.

H. H. CLUTTON.

SETONS.—A seton is a sinus produced artificially, and prevented from healing by means of some material passed along the track of it. Setons are chiefly used as counter-irritants, and in that case they are established in the subcutaneous tissue near the part it is desired to influence, e.g. in the temple or behind the ear in certain affections of the eye. As local irritants setons are not now much employed, but they used to be passed through cavities such as chronic bursal effusions and cysts, in order to excite inflammation and adhesion of their walls; in the form of drainage-tubes they are, however, still employed. Setons have also been used as a means of slowly evacuating the contents of chronic abscesses.

The orthodox material to use for keeping open a seton is known as a 'seton-tape,' and consists of a flat piece of gum-elastic tissue; it is introduced by a seton-needle, which is a broad, flat needle, with two cutting edges, and furnished at the heel with a clip, instead of an eye, for holding the tape. Both seton-needle and tape may be dispensed with, and instead of them, ordinary needles with eyes of suitable sizes for carrying one or more strands of wire, silk, worsted, or other material may be used. To establish a seton in the subcutaneous tissue, the skin should be pinched up between the finger and thumb, and the needle passed through the base of the fold, at such a depth that it is entirely below the skin, and the punctures at a sufficient distance apart that the vitality of the bridge of skin be not interfered with. The material used to keep open the sinus should be well oiled, and, after suppuration has been set up, a fresh piece of it should be daily drawn into the wound; if the gum-elastic seton-tape be used, it is only necessary to move it daily and keep it clean. The seton should be covered with some moist dressing, so as to prevent scabbing at the orifices and retention of discharges. If not itself sufficiently irritating, the tape may be smeared with savine ointment or iodine.

BILTON POLLARD.

SEX.—It is not possible to define sex; for it is not only the presence in the body

of certain organs and functions, and a certain state of the nervous system. It is a condition affecting the whole body, from the moment of conception; and the presence of visible sexual organs in the fœtus marks not the beginning of sex, but its advanced development. Van Helmont's saying, 'Propter uterum est mulier,' should be 'Propter mulierem est uterus.'

To the surgeon, the sex of a patient may be important in diagnosis, treatment, and prognosis; and sex is included, together with age, habits, and temperament, in that broad general view of each case which distinguishes those who wish to treat the patient as well as the disease. It is also of interest from the limits which it imposes on the transmission of disease and on its distribution, and from its relation to the comparative health and length of life of men and women.

We must first distinguish the *transmission* of disease from the *distribution* of it, and we must consider the influence of sex on each.

The relation of sex to the *transmission* of disease is to be studied in Darwin's *Animals and Plants under Domestication*, chap. xiv., and in Sedgwick's articles in the *Med.-Chir. Review*. It is well shown in those families where deafness, deaf-muteness, or imbecility has occurred among the daughters only. Ichthyosis also has been thus limited in transmission—in three families, to women; in one, to men. A malformation of the left ear has been transmitted to males alone; and malformation of the digits has gone, through ten generations, to females alone; but, in another family, to males chiefly. Albinism has affected only males, and only females. Many defects of the eye, especially myopia and colour-blindness, have been similarly limited; out of a total of thirty-two men and twenty-nine women, belonging to branches of a colour-blind family, there were twenty colour-blind, of whom eighteen were men, and only two were women; but in another family, there were in five generations thirteen persons colour-blind, all women.

Nor are malformations alone thus limited in transmission to one sex; every peculiarity tends to be transmitted in a greater or lesser degree to that sex in which it first appears (Darwin). This is shown in phthisis, and, sometimes, in other forms of scrofula. In these cases, 'the sons or daughters inherit the peculiarity, whatever it may be, from their father or mother, and transmit it to their children of the male sex.'

Or only a certain *disposition* to disease may be transmitted, as in cases where typhoid fever or measles has attacked one sex in a family more than another. Or it may be mere weakness, mere 'inability in one sex or the other to maintain life or to live beyond a certain age,' as in those families where one sex lives, but the other dies. Or, as in one instance (Sedgwick), two diseases may be transmitted, each limited to one sex, each having its proper distribution in the family.

Again, disease may be limited in its transmission as regards the sex *by* which it is transmitted. 'Generally with the hæmorrhagic diathesis, and often with colour-blindness, and in some other cases (gout, ichthyosis ?) the sons never inherit the peculiarity directly from their fathers, but the daughters alone transmit the latent tendency, so that the sons of the daughters alone exhibit it' (Darwin). The same tendency, though less marked, has been observed in phthisis; here the father transmits the disease to his son in about sixty per cent. of the cases, and to his daughter in about forty per cent.: the mother transmits it to her son in about forty per cent., and to her daughter in about sixty.

The general conclusion is, that disease tends to remain in that sex in which it first appears, but is often transmitted in a latent state through the opposite sex. To this conclusion must be added Darwin's two rules (*Descent of Man*, chap. viii.): that varieties, which first appear in either sex at a late period of life, tend to be developed in the same sex alone; and that variations, which first appear early in life, tend to be developed in both sexes.

These facts as to the transmission of disease make it evident that sex is, from the very moment of conception, a property of the ovum. Further proof of this may be found in the fact that in all cases of joined twins, as the Siamese and others, the two are always of the same sex, as though there had been a double or imperfectly-divided ovum, and each half had retained the sex which was the property of the whole ovum in the beginning.

If this be so, it is impossible that any influence should, after conception, affect the sex of the fœtus.

THE DISTRIBUTION OF DISEASE.—We must remember the difference between the *transmission* of disease, to one sex, or by one sex, and the *distribution* of it to men and women. The two things are wholly separate. Thus, where deafness and deaf-

muteness have been transmitted to one sex only, it has generally been to girls; but of 534 collated cases, 300 were boys. And colour-blindness may be limited in transmission either to boys or to girls; but of 200 cases, 180 were males.

The influences which decide the distribution of diseases among men and women are many. There are some diseases, as tumours of the breast, which are related to physiological changes in the part attacked. Others, as hernia, are related to the anatomy of the parts. Others, as chorea and hysteria, are related to perversion of the nervous system. Others, as some forms of cancer, are related to age, habits, and work. But in others, as in myxœdema (195 women to 15 men) and diabetes (738 men to 248 women—Brunton) it is hard to see what causes the unequal distribution.

At the moment of birth, male children are at a disadvantage; for they are, on an average, ten ounces heavier and half an inch longer, and their skulls are larger and more completely ossified. This may cause obstruction of the circulation, followed by inspiratory efforts, putting the child in danger of being choked by the fluids in the maternal passages (Hicks, *Croonian Lectures*). Also, hæmatoma is more common in new-born male children (Treves).

Before birth, two dangers beset the child—those of congenital deformity and inherited taint.

Congenital deformity is more common among boys than among girls; the following numbers, from various authors, show this clearly:—

	Boys	Girls
Harelip	44	20
Harelip with cleft palate	17	4
Ectopia vesicæ	14	2
Talipes, four simple forms	229	167
Malformation of rectum or anus.	68	32
But on the other hand we have—		
Spina bifida	879	1102
Congenital dislocation of hip	13	47

The rare congenital deformities of the chest (fissured sternum, absence of ribs over the præcordium, malformation of the heart and great vessels) are more common among boys.

It may guide us to a possible explanation of this strangely unequal distribution of the chief congenital malformations, if we divide this list into deformities of the face, deformities of the pelvis, and nervous deformities.

The deformities of the face are, perhaps, more common among boys because of their more advanced cranial ossification; either because some of the total energy of development is spent on the cranial bones at the expense of the facial, or because the greater size of the cranium, and its firmer ossification, tend to hinder union of the facial bones in the middle line.

Dr. Hicks's theory, that male children are more liable to deformities of the anterior median line, and females to those of the posterior median line, is not enough to explain all the facts; for deformity of the rectum and anus, which he says is commoner among girls, is really the opposite; nor is it, anyhow, to be counted among deformities of the posterior median line.

But the fact that arrested development of the acetabulum (congenital dislocation of the hip), and of the pelvic part of the large intestine, occurs mostly in girls, while arrested development of the symphysis pubis (ectopia vesicæ) occurs mostly among boys, may be related to the special shape and purpose of the female pelvis; just as in foetal life the female sacrum is already smaller than the male.

As to the prevalence of spina bifida among girls, it may be due to a less complete ossification of the spine, agreeing with the less complete ossification of the cranial cavity.

As regards hereditary taint, scrofula is equally divided, and so is rickets (but Guérin gives 148 boys to 198 girls). Inherited syphilis is equally divided; but certain forms of it are commoner among girls. Hutchinson, in his work on *Syphilitic Diseases of the Eye and Ear*, gives the following figures:—

	Boys	Girls
Keratitis	38	64
Iritis	5	18
Deafness	6	9

On the other hand, there is some reason for thinking that the rare tertiary forms of inherited syphilis are more common among boys.

In the first two years of life, the more advanced ossification of the skull is disadvantageous, as it is at birth, to male children. When irritation and hyperæmia of the brain occur, as often during dentition, the solid skull tends to increase the effects of pressure, as compared with the more yielding and mobile skull of the female. 'For, where the sutures or fontanelles are late in closing, the effects of dentition are not so severe' (Hicks). Hence the greater mortality of male chil-

dren from convulsions and from nervous affections of the larynx (Trousseau). Talipes is also related to a similar cause.

In 1866, the deaths registered from convulsions were:—

	Boys	Girls
During first year of life	12,438	9,353
„ second „	1,668	1,513
In 1868:—		
During first year of life	11,689	8,905
„ second „	1,480	1,367

After the second year, the distribution of nervous diseases between boys and girls becomes more equal. Chorea is more common among girls: 'As 3 to 1, and this proportion is still higher after puberty' (Trousseau). Of 422 out-patients at the Children's Hospital, there were 300 girls to 122 boys (Hillier). Incontinence of urine has a similar distribution; the common nocturnal form of it is more common among little boys, but the grave diurnal form is more common among girls about puberty. So sleep-walking (Chambers) becomes, after childhood, commoner among women.

'The period of puberty produces a greater disturbance, and causes a more rapid general development in the female than in the male. At this time, and at no other, the female, inferior to the male in stature and weight from birth onwards, rapidly catches him up and surpasses him; so that, between the ages of 12½ and 15 or 16, females are both taller and heavier than males. It is probable that this excessively rapid growth, together often with some drain upon the strength from the menstrual flow, renders the female sex an easier prey to tubercle than the male. At 10 to 15, in tables of phthisis drawn from different nations, in all the tables the female deaths are nearly twice as many as the male' (Handford, *Medical Times*, Nov. 1885). At this time also, hysteria, and the imitations of disease, and neuralgia and epilepsy are common among women; so also are anæmia, and malaise, and leucorrhœa, and inability to bear up against infection (Allchin). Some of these, as epilepsy, may also attack males first at puberty. But in women, the catamenia are a guard against disease, as well as a cause of it; thus the freedom of women from gout may partly be referred to the occurrence of the catamenia as a great safeguard (Garrod).

Other diseases, which frequently arise at or near puberty, are exophthalmic goitre (42 females to 8 males—Trousseau; 77 to 12—Beigel); ulcer of the stomach (in 234

cases of perforation, 160 were females—Brinton); and lateral curvature (151 to 22—Noble Smith). But these numbers are drawn from hospital practice, and there is need of statistics of the same diseases among the upper classes of society.

As regards marriage, and its influence on health and length of life, a few lines will suffice for the following statistics, drawn from the French registers by M. Bertillon (*Medical Times*, ii. 71). The deaths per 1,000 males yearly are—

	25-30	30-35	35-40
Bachelors	10	11	13
Married men	6	7	7.5
Widowers	22	19	17.5

And so for all other ages. But very early marriages give results of their own: young married men, aged 18 to 20, die at the same rate as men aged 65 to 70. To women, the gain from marriage is less evident: thus, from 30 to 35, the deaths per 1,000 yearly are 11 single women to 9 married. Of women of 25 to 30, the deaths are 9 unmarried, 9 married, and 17 widows. Of women under 20, the deaths are 7.5 unmarried to 11.8 married.

The calculation of probabilities shows that a man aged 20 to 25 adds five years to his life by marriage, and a woman of the same age adds 4 to her life.

Pregnancy, says Dr. Allchin (*Medical Times*, Dec. 5, 85), though it brings the risks of nervous disturbances, or of albuminuria, only raises the death-rate by $\frac{1}{2}$ to 1 per cent. Primiparæ die at the rate of 1 in 62, multiparæ at the rate of 1 in 124. The deaths of pregnant women, from causes not connected with their delivery, were only 55 in all the year 1883. Among diseases related in some way to pregnancy, and so more common among women, are floating kidney (87 to 10 men—Landau), and mollities ossium (85 females, in whom the disease either appeared during pregnancy, or was modified in its course by this condition—35 others—11 males. See *Erichsen*, ii. p. 307).

The menopause, though it may bring neuralgic pains, flushings, and other congestions, or a revival of slight diseases of girlhood, long in abeyance, may have a good effect on the organism, ridding it of chronic ailments, or stopping the growth of uterine fibroids (Allchin).

Old age, in relation to sex, is best comprehended in a short survey of male mortality and longevity, as compared with female. (See Dr. Allchin's Lectures.) In 1883, of 1,000 persons living, there were

487 males and 513 females; and at all periods of life females are either equal in number to the males, or exceed them. But, for every 100 females born, there were born 103.5 males. Therefore (though this greater number of male births is now somewhat diminishing), there must be a higher male death-rate, and we find that for every 1,000 persons there died 19.5, in the ratio of 20.6 males to 18.4 females. Again, in both sexes, the mortality is becoming less: thus in 1871-80 the death-rate was only 21.27 per 1,000 yearly, which is less than it was in any previous decennium; but while the male death-rate sank only 4.24 per cent., the female sank 6.02. Again, though infant mortality is becoming less, the mortality of adults is increasing; but while the male adult death-rate is increasing for all over 35, the female death-rate is increasing only for those who are over 45.

Hence, the mean expectation of life of a male child at birth is 41.35 years, and of a female child is 44.62. But the mean expectation of annual sickness, estimated by Mr. Sutton, is almost exactly the same for the two sexes:—

Age in years	Weeks of sickness in a year	
	For men	For women
15 to 20666	.666
20 to 25737	.737
25 to 45995	.995
45 to 65	2.736	2.751

Since women have as much sickness as men, and yet have a lower death-rate, they must either be more favoured by circumstances, or they must also have a superior vitality. Evidence for the latter view may exist in the heavy mortality of male infants, and in the fact that most very old folk are women. Thus, of centenarians, the numbers were, in 1873, 79 to 10; in 1881, 66 to 25; in 1882, 54 to 17 (Humphry, *Lancet*, May, 1885). In phthisis, the statistics of different nations are widely different; in England, during 1871-80, they show that, from 5 to 25, women suffer more; but after this they suffer less than men (Handford); and this also may be evidence of superior vitality.

Here we may consider how, as surgical patients, men and women differ. 'As a rule,' says Mr. Savory (*British Medical Journal*, i. 1873), 'women are unquestionably better subjects, in respect of temperament, for injury or operation, than men; not because they usually have more courage, in the ordinary acceptance of the term, but because they have, in this sense, more endurance. It is the passive, rather than

the active quality, which avails them. If they can do less, they can suffer more. And, again, see the advantage of calmness and resignation as opposed to impatience and restlessness. A man will often meet the suggestion of an operation as a soldier will volunteer for a forlorn hope, while the hint of such a thing to a woman will sometimes prostrate her. But then each has to submit to it, and, when the thing is done, as time goes on, qualities of another kind come into play, in which, in her turn, the woman surpasses the man.'

'Persons of an irritable and nervous disposition do not bear operations so well as those of a more tranquil mental constitution. Those also of a feeble and irritable habit of body, especially nervous and hysterical women, with but little strength of circulation, cannot bear up against severe surgical procedures, and often sink after comparatively slight ones; being apt to become depressed and to sink without rallying' (Erichsen).

As regards operating during the catamenia, Mr. Savory says: 'If the period of the catamenia has been miscalculated, or they appear irregularly at the critical moment from anxiety or excitement, much must depend on the patient and the disease; but I believe that by running whatever risk there is, I choose the less evil of the two.' 'As with menstruation, so, much more, during pregnancy, you would not willingly operate. And yet, with the exception of the danger of producing abortion, I know no facts that would imply a greater than the average risk; while it would be mere recklessness to operate on such patients without good cause, yet if good cause for operating exists, they may be treated very hopefully. When women are suckling, they will bear operations with no more than the common risk that might attach to persons who may be in comparatively feeble health. But an exception must be made, I believe, for operations on the breast' (Sir J. Paget, *Clin. Lectures*).

Last, as regards the relative frequency of a few of the chief diseases.

1. Stone in the bladder is especially rare in female children. Among men and women the proportion is 1 to 20, or more, of cases operated upon. 'Owing to the shortness and large size of the urethra in females, many small stones are voided by them that would be retained in the male' (Erichsen). Perhaps the prevalence of tumour in the male bladder (eighteen out of twenty cases—Thompson) may also be related to the anatomy of the parts concerned.

2. Of rectal diseases, fissure, prolapse, and stricture are commoner among women: of 28 cases of stricture, 20 were women; 'and in 9 of them the disease commenced after labour, in some instances being distinctly attributed to an injury at that time' (Curling). But piles, fistula, and cancer are commoner among men; cancer, from different authorities, is 44 to 23.

3. *Hernia*.—Mr. Birkett has constructed the following table, from Mr. Kingdon's statistics in 1860–61:—

Ages	Inguinal		Femoral	
	M.	F.	M.	F.
1 to 20 . . .	2,435	249	23	38
20 to 40 . . .	2,954	322	139	432
40 and upwards	2,154	128	144	278

4. *Aneurism*.—All diseases related to arterial degeneration are commoner in men—e.g. angina pectoris (80 to 8—Forbes; but see Trousseau, *Clin. Med.*, vol. i.) and senile gangrene. Of Crisp's 551 cases of aneurism, more than seven-eighths were in men. But aneurism of the carotid, and internal aneurisms, are more evenly distributed.

5. *Rodent Ulcer*.—Of 42 cases, 20 were women (Hutchinson, *Medical Times*, Oct. 1860). Of cancer of the lip, Hutchinson gives 127 cases, including 5 of the upper lip or angle of the mouth. Of these 127, only 6 were women; and 3 of these women were smokers. As regards cancer of the tongue, Sibley, in 1857, gives 9 men to 5 women; Hutchinson, in 1860, gives 13 to 6; Humphry, about the same year, gives 7 to 9; Baker, in 1862, gives 19 to 11. But a recent set of private cases gives 44 to 2; and the cases in St. Bartholomew's Hospital in 1883 were 23 to 1. (Compare Mr. Barker's tables in Holmes's *System*.)

Mr. W. R. Williams has just published full statistics of the distribution of the various diseases, medical and surgical, to men and women, in his valuable work, *The Influence of Sex in Disease*.

STEPHEN PAGET.

SHAMPOOING. See MASSAGE.

SHOCK.—*Etiology, &c.*—Shock is that state of general depression of vital activity, into which a person passes who has been subjected to severe injury, emotional disturbance, &c.; or, in other words, who is suffering from the general depressing effect produced upon the central nervous system by a violent stimulation of the peripheral nerves and nerve-endings.

The general effect of the excessive 'irritation' of the central nervous system will consequently, *cæteris paribus*, vary directly

with the degree of the stimulating force, as will presently be shown to be the case, while, at the same time, this effect is modified by the very obvious differences between the circumstances of individual sufferers.

The condition, in most cases, is not merely produced through direct irritation of the nervous system, but is very frequently deepened, and the symptoms rendered much more severe, by such simple though fundamentally important complications as exposure to cold, loss of blood, previous acute illness, &c. In fact, the first two of these predisposing conditions are to be looked upon occasionally as themselves causes of shock, and will be referred to as such below.

The effect, moreover, is not always the same, although the exciting cause may be identical, for two distinct kinds of shock were observed by Travers—viz. one in which great prostration is the principal feature of the case, and another in which the patient, although apparently exhausted, passes into a condition of traumatic delirium. The consideration of the latter of these, termed prostration with excitement, will be postponed until the more ordinary case of depression has been described.

I. SHOCK WITH DEPRESSION.—*Causation.*—(1) *Seat of Injury.*—Shock is especially apt to follow injuries of the head, abdomen, urethra, testicle, digits, and thorax. Thus, it occurs as a result of lesions of those parts which are most richly supplied with sensory nerves, and also those which contain the most important viscera, and are consequently intimately connected with the medulla oblongata by means of the vagus (and trigeminus) nerve. The liability of urethral operations to be succeeded by shock, is undoubtedly due to the intimate relation between the lumbar enlargement of the spinal cord and the process of excretion of the urine. See URETHRAL FEVER.

(2) *Mode of Injury.*—The commonest kind of injury which produces shock is the result of a crushing force applied to the body—one, therefore, which damages a number of branches of the sensory nerves. For the same reason, blunt and large instruments cause shock by the wide area over which they operate, and also from the fact that they inflict a contused or lacerated wound, which causes more energetic irritation of the nerves. So with burns of the surface of the body: it is an old axiom that the important factor in the causation of fatal shock, in these cases, is not the depth or degree of the burn so much as the extent of the injury.

The converse injury—namely, cold—probably acts in the same way, and is a powerful adjuvant in helping to produce shock in operations, which from their nature and seat would not specially cause it. Here it may be noted that Hewson found shock to be most severe in the extremes of winter and summer—i.e. when the system is most depressed.

But while the influence of the extent of the injury has been long recognised, further inquiry shows some particular operative measures to be more active than others in producing this condition, and these may be summed up as those which involve laceration of the nerve-fibres. Thus, Mr. Jordan has shown, in cases of amputation, the strikingly sudden effect produced on the pulse and temperature by the simple act of saving the bone; so that while the rapid division of the soft parts with a keen-edged knife had very little effect on the narcotised nerve-centres, the laceration of the few osteal nerves caused immediate and marked depression. This phenomenon is not very comprehensible, except on the assumption that it is the mode of injury which wholly determines the effect, when it is remembered that division of a bone with the saw is not a very painful process, unless the section be carried through the bone near the point of entrance, into the marrow, of the trunk of the nerve supplying it.

A practical illustration of the same fact is noted by Pirogoff, who, in the days before anæsthesia was employed, observed that patients sank with extraordinary rapidity immediately after division of the bone.

(3) *Influence of Age and Sex.*—The question as to whether either sex is less liable to shock, is quite indeterminable with our present means of information, and any surgical procedure should not, consequently, be based upon such generalisations—as, for instance, the fact that women do not, generally speaking, meet with so severe a struggle for existence as men, and therefore have a greater reserve of power to fall back upon—but must be decided upon according to the peculiarities of each case. As for the influence of age, all surgeons are agreed as to the especial severity of shock when it occurs in people already the subjects of senile degeneration, it being of course understood that such degenerative change is not necessarily the accompaniment of prolonged life.

As regards the occurrence of shock in children, it is to be observed that, like adults,

they suffer extremely from the causes of shock when those causes are applied over a large area of the body, as for example in cases of burns and exposure to severe cold. In fact, their liability to suffer under these circumstances would appear to be greater than in the adult. As far, however, as operative measures alone go, there is no doubt whatever that the nervous system of the child is less influenced by traumatism than that of the adult. Elaborate clinical evidence in illustration of this point is not to hand, but its general truth, being supported by abundant experimental evidence, cannot be doubted, and is therefore to be considered as forming safe ground for action under circumstances of doubt.

(4) *Nervous Temperament.*—In all neurotic, excitable subjects, the effects of shock are naturally more severely felt, and, on this point, may be mentioned the changes, in the time of onset and duration of this condition, which are wrought by the mental condition of the subject at the time of receiving the injury. Thus, if the patient is harassed by expectation, from actual foresight, of the impending mischief, the effects will develop with great rapidity and cause urgent symptoms. On the other hand, if the patient's mind is attentively occupied with some idea of absorbing interest when he is injured, the symptoms of shock will be postponed, but will be more marked when they do occur, owing to the previous exhaustion of the nerve-centres. Such cases are of common occurrence after battles, &c.

(5) *Previous Loss of Blood.*—This acts so obviously as a predisposing cause of shock—viz. by depleting the nerve-centres—that it needs only mention here; at the same time it should be remembered that the failure of the heart, which occurs in cases of severe hæmorrhage, and which therefore gravely deepens the symptoms of shock, is in many cases due simply to emptiness of the heart's cavities, and thus its urgency can be removed by transfusion. See *Treatment*.

(6) *Previous Illness.*—The effects of previous illness upon the occurrence of shock vary according to the following simple rule—namely, that where previous illness has not caused any visceral disease or degeneration, and has (owing to treatment, &c.) practically only had the effect of confining the patient to bed, so far from predisposing to shock, it is a prophylactic against it. Where, on the other hand, it can be shown that previous illness has caused chronic changes, especially in the excretory

organs, severe shock is to be expected. This fact is, of course, of great importance in deciding the propriety of performing a severe operation upon a case of long-standing joint-disease, &c.

Symptoms.—A person, who has been subjected to one or more of the foregoing causes of shock, exhibits the following symptoms, which are here classified according to the anatomical centres, the derangement of which leads to their production.

General Neurotic Symptoms.—The patient lies flat on his back, usually conscious but not emotional, and exhibiting all evidences of general paresis of volition. Thus, the limbs lie flaccid, usually just where they are placed; he makes no so-called spontaneous movements; the upper eyelids fall so as to half-close the (frequently upturned) eyeball. The eyes are sunken, the skin of the face expressionless and showing well-marked longitudinal folds. The sphincter ani is usually relaxed, and the urine retained in the bladder. Speech is clear, but feeble and sometimes slow, while the intellectual operations preceding an answer to a question are often delayed, and ability to think and reflect, for even a short time, is abolished.

Bulbar Symptoms.—Frequently, no doubt, as an effect of direct reflex action on the vagus centre (cardiac centre), the pulse, slow (according to Jordan) soon after the injury, becomes frequent and remains so till death in fatal cases, as if, apparently, the inhibitory action of the vagus centre were removed. At the same time, it is irregular both in force and rhythm, the force gradually diminishing until the pulse becomes imperceptible, the respiratory movements continuing.

Respiratory Centre.—Respiration throughout is enfeebled and the action of the centre becomes irregular, while inspiration is often accompanied by sighs of variable depth and frequency.

Vaso-motor Centre.—Cases of shock are so frequently complicated by hæmorrhage, that it is difficult to accurately account in all cases for the customary pallor of the skin and mucous membranes; as far as can be made out, there is, first, vasal constriction, which, however, is soon followed by paralysis of the vessel-walls, so that while most of the surface of the body is of a dead white colour, certain portions are darker and even cyanotic, which condition is also kept up by the feebleness of the circulation.

Temperature.—The temperature of the body is customarily lowered from one to three degrees, in fatal cases frequently sink-

ing below 95° F. In some cases which end fatally, the temperature has been observed to rise again after the preliminary fall, and it may even reach 99° before death, the other symptoms also undergoing slight relaxation.

Deglutition Centre.—Voluntary swallowing is impaired, as are all voluntary acts, but the centre in the medulla for the constrictor action of the pharynx, &c., remains active, except in very severe cases, when its function may be abolished.

Vomiting Centre.—The sensation of nausea, which is felt by persons who are suffering from impending syncope, finds its highest illustration in the vomiting produced by shock. The occurrence of vomiting is very variable in time, but very constant in appearance. Thus, it may occur very soon after the accident or at any period afterwards, when some of the other symptoms have disappeared.

Sensory Symptoms: Special Senses.—The perceptive centres, &c., for the special senses are usually unaffected, except in very severe cases, when there may be almost complete anæsthesia and analgesia. Indeed, severe operations have been painlessly performed in this condition, even while the patient was watching all the details. Sometimes paræsthesiæ are well-marked, and sensation of cold (frequently, of course, of actual objective origin) and numbness are complained of.

Miscellaneous Symptoms.—Owing, probably, to vaso-motor changes rather than to direct activity of secretion ('paralytic'?), the skin is moistened by a cold clammy sweat, which occasionally collects in large drops, but, as a rule, is less marked than is usually stated. In accordance with this view, it is to be noted that secretion from other glands is arrested; thus, for instance, there may be absolute suppression of urine.

Pathological Anatomy, &c.—Besides the anæmia of the body-surface, described above, there is also found, in many cases, anæmia of the central nervous system, while the heart is in a state of diastole and the right side full of dark blood. The veins of the abdominal viscera are also said to be engorged, and, if the case is one of uncomplicated shock and one in which the splanchnic system is obviously engorged, we have an easy explanation of many of the vaso-motor symptoms; but on this point post-mortem evidence is by no means complete. In three cases of simple shock examined by the writer, the mesenteric vessels were not markedly full at all. Of course, if there were reflex paralysis of the splanchnic

nerves, or depression of the vaso-motor centres governing the splanchnic vessels, then it is quite probable that the anæmia of the surface and the brain is due to the blood filling the dilated visceral vessels. As the symptoms, however severe, have been shown to be due to simple diminution of function, it is not surprising that no grosser changes than those just described are to be found in this condition.

Diagnosis.—Confusion of this condition with others is scarcely possible, save with concussion of the brain and syncope. Since in the former we have, as the principal effect, diminution of function of the central nervous system, the two states are really nearly identical and do not require separating except for purposes of treatment. General considerations will always suffice to decide, and Fischer points out that the pulse is a fair guide to differentiate the two conditions, being slow and regular, often full, in the case of direct injury to the brain, small and irregular in cases of shock. The complication of anæmia from loss of blood will be easily discovered, and treated accordingly.

Prognosis.—The prognosis depends so entirely on the details of each individual case, that nothing can be said here save that all judgment must be based solely on the evidence afforded by the pulse and temperature. There is, however, a most important prognostic question connected with shock, which may fittingly be discussed here—namely, at what period and under what circumstances is it justifiable to operate upon a person suffering as above described.

First, all surgeons are agreed that it is in no sense justifiable to operate on a person the subject of shock, except in the special case when it is perfectly clear that the damaged portion of the body is (by causing pain, &c.) prolonging and adding to the severity of the condition. Guthrie laid down, as a practical rule, that the surgeon should wait until the patient recovered his sensibility to the pain of the injury, or, in other words, until reaction or gradual recovery has led to the nearly complete re-establishment of function in the nervous system.

Next, most surgeons are now agreed upon the fact that an anæsthetic does little to deepen shock. It certainly depresses the temperature of the body, but equally certainly appears to give rest to the nerve-centres in their progress to recovery, and of course to a large extent protects them from experiencing further depression. Therefore, we may clear the ground by saying that anæsthetics should always be

given, and further, that as a rule ether is the best narcotic agent to employ, since it is at the same time a powerful cardiac stimulant.

In short, the ordinary practice is to wait for some reaction except in the case referred to; but, in all instances, the consideration of the peculiarities of each case will guide the surgeon in modifying the application of these principles, which consequently can only be expressed in general terms.

Treatment.—The treatment of shock may be very conveniently summarised under the following heads—Pulse, Respiration, and Temperature, it being understood that the cause of shock has been removed as far as possible.

Pulse.—The pulse practically is the main guide in the direction of treatment, especially as it affords direct evidence of the condition of the heart, failure of the action of which appears to be almost always the immediate cause of death.

The choice of stimulants, alcoholic or otherwise, must depend upon the degree of shock, the mode of injury, and the state of the patient's heart, &c. If there is not much nausea, hot strong beef-tea should be given in small quantities by the mouth, or if vomiting has already set in, it must be injected into the rectum, the anus being plugged if the sphincter is relaxed. Ammonia (liq. ammon. aromat. fʒj.), ether (fʒj. in aromatic water), alcohol fʒj. (as brandy or champagne, preferably the latter), may be given every half-hour (more or less frequently according to the necessities of the case) until the pulse is improved. The pulse must be carefully watched, and the stimulant diminished as soon as the quality of the heart-beat is improved. In this way, post-stimulation, depression, and over-excitement of the heart's action will be avoided. If the injury or operation is causing much pain and therefore reflex depression of the heart, morphia (gr. $\frac{1}{4}$) should be given hypodermically, and the dose increased if not sufficient, but it must be remembered that the action of morphia is cumulative.

The momentary application of a very hot cloth or plate to the cardiac area will often spur up a sluggish heart, and in severe cases hypodermic injection of ether should be given, fʒss. to fʒj.

Respiration and Temperature.—The bodily heat and the respirations commonly vary together, and, as they are intimately connected with one another causally, may be considered in terms of the temperature. If the temperature falls, loss by radiation

must be prevented, the patient must be well but lightly covered with blankets, and hot bottles put by his extremities, and one on each side of the thorax. (It will be remembered that sensibility to pain may be deadened, and that hot bottles must be guarded from the skin.) As soon as the temperature of the body returns to normal and remains so for about half an hour, the hot bottles should be removed or only left at the feet.

Hæmorrhage.—So much of the urgency of shock being due to loss of blood, it is necessary to consider the two immediate effects it exerts on the system. The first of these is insufficient supply of blood to the nerve-centres (bulbar especially), with the production of dyspnoea and, often, jactitation as symptoms; while the second is cardiac failure owing to the heart-cavities being insufficiently filled with blood.

The first condition is best met by lightly bandaging and raising the limbs, while artificial respiration is kept up gently but industriously. In one case in which the natural respiratory movements ceased three times, recovery was ultimately obtained by this method. The second symptom, which is sometimes accompanied by a semi-comatose state, must be treated by bandaging and raising the limbs as before. If this does not speedily (fifteen minutes) produce a change in the heart-beat, transfusion should be performed at once. It is not necessary to use blood for this purpose; several saline fluids have been used with success, and one consisting of water 1000 parts, pure sodium chloride 6 parts, sulphate of soda 2 parts, carbonate of soda 1 part, appears to combine the advantages of most which have been put forward since Schwarz established the scientific value of the operation. A quantity equal to the amount of blood supposed to have been lost should be injected into a vein, after careful filtration and warming. Not less than 500 cubic centimètres should ever be injected. See TRANSFUSION.

Prophylaxis.—When shock is to be expected to follow an operation, the patient should be given a small dose of morphia (gr. $\frac{1}{4}$) hypodermically a quarter of an hour before the operation, and then the limbs should be lightly bandaged with cotton-wool.

II. SHOCK WITH EXCITEMENT.—*Pathology.*—Travers, who first drew attention at any length to the condition which passes under the above title, considered that the nervous system was affected, as in the ordinary case of shock, by depression with

atony; but that, instead of this ending in paralysis, it passed into a state of hyper-excitability which led to absolute exhaustion. In fact, he described the condition as one of premature and excessive 'reaction.' The pathology of this certainly rare condition has been rendered rather obscure by some writers, who have clearly included under the same heading distinct cases of sapræmia. In the majority of instances, it will be found that the first symptoms appear very early—viz. two to four hours after the operation, that the excitement rapidly reaches a violent degree, and that the fatal coma follows in from fifteen to forty-eight hours after the accident or operation. From this, it does not seem unscientific to conclude that the whole series of phenomena are those of atonic hyper-excitability of the nerve-centres, although it is always to be remembered that there is almost invariably an open wound, and always some extravasation of blood; so that, the possibility of the symptoms being due to pyrogenic absorption never being absent, the question of its true pathology must be left entirely open.

Symptoms.—The patient usually recovers rapidly from the anæsthetic, speaks very hopefully of his condition, and seems in a very favourable state. In a very few hours, however, he will be found to have distinct delusions (the same thing is often seen in patients recovering from the effects of ether), and to be suspicious of those around him. He talks volubly and soon quite incoherently, the respirations are hurried, the apex-beat thrilling and the pulse weak; he tries to get out of bed, is evidently insensible to pain, as he tears off dressings and freely moves the injured part. In this state of excitement the patient cannot be calmed by reason, and finally becomes wildly maniacal. As a rule, very little force is required by way of restraint, as the muscular power is so much reduced. After some hours the signs of shock with depression gradually come on, the pulse becomes very small and quick, the temperature falls, the pupils dilate, &c., and the patient dies exhausted. In some cases, the maniacal state is interrupted by short intervals of comatose apathy and exhaustion.

Prognosis.—Practically fatal, and the condition continues till death.

Treatment.—Nothing has been added to the treatment advocated by Travers—viz. opium, food, and stimulation. Any narcotic to the nervous system, such as hyoscyamus, chloral, paraldehyde, may be tried, but probably without much success.

VICTOR HORSLEY.

SHOULDER, Diagnosis of Diseases and Injuries about the.—The angle of the shoulder is formed by the acromion process of the scapula and the outer extremity of the clavicle, whilst rotundity is imparted to it by the upper end of the humerus and the deltoid muscle. Broad square shoulders are usually taken to indicate manly strength, and depend on a wide chest, long clavicles, and well-developed deltoids; while sloping narrow shoulders indicate delicacy. One shoulder higher than the other is nearly always due to LATERAL SPINAL CURVATURE. It is common in girls about the age of puberty, but usually takes origin in rickets of an early period, and at this climax becomes more pronounced as the result of habit or weakness. High shoulders may so appear because associated with a congenitally short neck, but, when amounting to deformity, they usually indicate ANGULAR CURVATURE OF THE SPINE in the upper dorsal or cervical region. Drooping forwards of the shoulders gives rise to projection of the posterior margins of the scapulæ, and is a sign of *general muscular weakness* such as is seen in too rapidly growing youth and in the decadence of age. Drooping shoulders and rounded back, the so-called 'round shoulders,' are also frequently the result of CYPHOSIS. An oblique direction of the scapula may result from paralysis of the serratus magnus, and rotation with projection of the lower angle from slipping of the latissimus dorsi muscle.

A fall on one shoulder may give rise to fracture of the clavicle, dislocation of the acromio-clavicular joint, fracture of the acromion, dislocation or fracture of the upper end of the humerus, or fracture of the neck of the scapula. *Fracture of the clavicle* occurs most frequently just externally to the middle; the shoulder drops downwards and forwards, and the outer fragment is almost invariably below the inner. The line of fracture can be felt, and crepitus can be elicited by drawing back the shoulder. Fracture between the ligaments (conoid and trapezoid) may be attended with no displacement, and is then to be detected only by pain and crepitus. See CLAVICLE, Fracture of the.

In *dislocation at the acromio-clavicular joint*, the acromion process is almost always displaced downwards and inwards beneath the clavicle, and the outer extremity of the latter forms a well-marked projection above the point of the shoulder. In the rare cases in which the acromion is displaced upwards, its free end can be readily felt

riding over the clavicle. See SCAPULA, Dislocations of the.

In *fracture of the acromion* the outer fragment drops with the shoulder; the interval can be felt, and pain and crepitus will be produced by pressing up the head of the humerus. The acromion is sometimes united to the spine of the scapula by fibrous tissue, and, if the surgeon is in doubt as to this condition, he should examine the other shoulder, as the condition is usually symmetrical. See SCAPULA, Fracture of the.

An angular appearance of the shoulder may be due either to atrophy of the deltoid or to displacement of the upper end of the humerus. *Atrophy of the deltoid* may be consequent upon disease or ankylosis of the shoulder-joint; it may follow injury to the muscle or to the circumflex nerve; in children it may be due to infantile paralysis, and in adults to progressive muscular atrophy. When due to paralysis, the joint-movements are free.

Dislocation of the head of the humerus invariably renders the angle of the shoulder more acute; this appearance is most marked in the subglenoid, and least evident in the subspinous form. Further, there is limitation of movement, the elbow projects from the side, and the head of the bone can usually be felt in one of the four characteristic positions. See SHOULDER-JOINT, Dislocations of the.

Fracture of the neck of the scapula is met with in two forms, both of which are rare. In the commoner form, the coracoid process is broken off with the glenoid cavity and is movable; in the other, the fracture is external to the coracoid process, which remains fixed. The shoulder is more angular than normal from dropping of the humerus with the glenoid cup, but there is no fixation, and the arm is lengthened. Crepitus is obtained by pressing up the humerus; at the same time the deformity disappears, but recurs when the force is withdrawn. See SCAPULA, Fracture of the.

Fracture of the surgical neck of the humerus is not uncommon, and gives rise to a marked deformity. The upper fragment is displaced upwards and outwards by the muscles attached to the great tuberosity, and immediately beneath it there is a slight depression; whilst the lower fragment is drawn in beneath the coracoid process, where it can readily be felt, especially when the elbow is raised upwards and outwards. There is increased mobility, and crepitus is elicited by extension, the deformity recurring when extension is removed.

Separation of the upper epiphysis of the humerus may occur under the age of twenty. The deformity is the same as in fracture of the surgical neck, but the end of the lower fragment is less angular and bony crepitus is absent. See HUMERUS, Fractures of the; SEPARATION OF EPIPHYSES.

Diseases about the shoulder are numerous, but less complicated than the results of injury. LIPOMATA are not uncommon; they are painless, movable, semi-fluctuating, but feel solid and lobulated when pressed laterally. A BURSA is sometimes met with on the point of the shoulder in those who carry weights; it is adherent, has a thickened margin, and a fluctuating centre which yields clear glutinous fluid on puncture. GUMMA may be met with at the back of the shoulder; the history and concomitant tertiary signs of syphilis would assist the diagnosis. SEBACEOUS CYSTS are known by their relation to the skin, which they thin out and are adherent to; they fluctuate, and the skin is often discoloured over them. HÆMATOMA or ABSCESS may follow injury. Other tumours commencing in the superficial structures are rare.

On the bones *nodes* (see SYPHILIS) may occur, attacking either the clavicle, acromion, spine of the scapula, or humerus. They cause thickening, pain at night, sometimes fluctuation and tenderness, and are associated with other syphilitic symptoms present or past. EXOSTOSES are known by their slow growth and extreme hardness; ENCHONDROMATA by slow growth and rounded elastic nodules on the surface. SARCOMATA are more uniform on the surface and of more rapid growth; they sometimes lead to spontaneous fracture. *Myeloid sarcoma* may attack the upper extremity of the humerus in young persons, gradually expanding and absorbing the bone till a thin shell-like layer is left, or only periosteum.

Inflammatory conditions of the bones are at first associated with local or general fever, and, should necrosis follow, sinuses will form, and new bone be deposited around the old. See PERIOSTITIS.

Disease of the acromio-clavicular joint is very rare. The joint being subcutaneous, the consequent swelling is readily detected. The writer once saw this joint suppurate in the course of pyæmia.

Sprains and injuries of the shoulder-joint are apt to lead to pain and limitation of movement, lasting for weeks or months, accompanied by *circumflex neuralgia*. This neuralgia is especially felt about the middle of the outer side of the arm, over

the insertion of the deltoid, where the circumflex terminates in cutaneous filaments. In consequence of the deltoid covering the shoulder-joint, SYNOVITIS causes no very characteristic appearance, but when the effusion is great, swelling may become evident below the acromion behind, and external to the coracoid in front.

Chronic disease of the SHOULDER-JOINT gives rise to muscular fixation, which causes the scapula to move with the arm, a sign of the utmost importance when examining a child. In a young person of strumous diathesis, the joint-disease may take the form of *pulpy degeneration of the synovial membrane*, or it may be that the disease commenced in the bone as *strumous epiphysitis* or *articular ostitis*, and extended to the joint. In the cases of pulpy disease, there is usually a doughy white swelling about the joint, and little pain till the later stages, when the cartilage has been removed; whereas in epiphysitis or articular ostitis the pain is severe, and the swelling at first confined to the region of the bone. *Syphilitic epiphysitis* occurs in infants the subject of inherited syphilis, and gives rise to 'pseudo-paralysis.' Sometimes the epiphysis becomes separated, when increased mobility and cartilaginous crepitus may be detected on manipulation.

The foregoing inflammations have a tendency to suppurate in the later stages, whereas the *rheumatic*, *gouty*, *ataxic*, and *osteo-arthritis* have little tendency to supuration. The rheumatic and gouty may be referred to the constitutional habit; the ataxic (Charcot's joint-disease) is associated with locomotor ataxy; and osteo-arthritis occurs most frequently after the middle period of life, and gives rise to a creaking joint having bony outgrowths around. All chronic diseases of the shoulder-joint lead to wasting of the scapular muscles.

Subdeltoid bursitis may be confused with joint-inflammation. It gives rise to a uniform fluctuating swelling beneath the deltoid, and pain is felt during active movements in which this muscle contracts, but passive elevation of the arm relieves the pain.

R. CLEMENT LUCAS.

SHOULDER-JOINT, Amputation at the.—Amputation at the shoulder-joint is one of the greater surgical operations, which, as a rule, is attended with excellent results. The cases indicating it are compound comminuted fractures (frequently the result of gunshot injury), malignant tumours, extensive necrosis, and aneurism. They are, in truth, so various that no one method can

be specially recommended. These amputations are six in number—(1) The circular method (Alanson, Velpeau); (2) the oval method (Larrey); (3) the antero-posterior flap method (Lisfranc, Desault); (4) modified oval method (Spence); (5) external square-shaped flap (La Faye, Richeraud); (6) semicircular flap by transfixion (Dupuytren).

To Alanson is due the credit of having first performed and described amputation at the shoulder-joint by the *circular method*, the principle of oblique division of the muscles being adhered to. He commenced the circular incision through the integuments a hand's breadth below the acromion, and then obliquely divided the muscles up to the capsular ligament. 'The tendon of the biceps and the capsular ligament upon the anterior and posterior part of the joint were now cut through. One of the circumflex arteries, which bled a good deal, was next tied. The great pectoral muscle, the rest of the capsule, and all the other parts except the vessels and nerves were then divided, but previously to cutting the vessels a temporary ligature was put around them.' This operation with slight modifications has been practised and advocated by several operating surgeons of repute, notably by Velpeau, who believed that no method gave better results or could be performed with greater expedition than the circular. However, notwithstanding these high credentials, this operation is now seldom, if ever, performed, chiefly on account of its being, as Mr. Lane observes, 'more difficult of performance than the other methods.'

In cases of fracture or tumours of the arm indicating amputation at the shoulder, the *oval method* of Larrey, or Spence's modification of it, is preferable. The former is thus performed. A straight incision is made on the outside of the shoulder, from the tip of the acromion vertically downwards for a distance of an inch and a half or two inches. The deltoid is thus divided into two equal parts. The integuments being drawn up towards the shoulder by an assistant, the anterior and posterior flaps are formed by 'two oblique strokes of the knife made from within outwards and downwards, so as to cut through the tendons of the pectoralis major and latissimus dorsi.' The flaps are then raised and the joint exposed. An incision over the head of the bone divides the capsule and tendons in immediate connection with the articulation. The head of the bone being rotated outwards, the posterior ligamentous structures are divided; the knife is then carried

downwards and outwards through the incision on the inner side, an assistant at the same time compressing the artery in the flap; and finally the knife is directed backwards, dividing the axillary vessels. These are then tied, the divided circumflex vessels being subsequently secured.

Mr. Guthrie has also described a method of amputation at the shoulder by an oval incision, which in the main is closely analogous to Larrey's operation.

The late Prof. Spence, of Edinburgh, described a modification of Larrey's operation, which it is alleged, results in a more shapely stump, and in which disarticulation is more easily accomplished. Another advantage claimed for it is that only the terminal branches of the posterior circumflex artery in front are divided. The operation had best be described in Prof. Spence's words:—'The arm being slightly abducted, and the humerus rotated outwards, I cut down upon the head of the humerus immediately external to the coracoid process, and carry the incision down through the clavicular fibres of the deltoid and pectoralis major muscles till I reach the humeral attachment of the latter muscle, which I divide. I then, with a gentle curve, carry my incision across and fairly through the lower fibres of the deltoid towards, but not through, the posterior border of the axilla. Unless the textures be much torn, I next mark out the line of the lower part of the inner section by carrying an incision through the skin and fat only, from the point where my straight incision terminated, across the inside of the arm to meet the incision at the outer part. If the fibres of the deltoid have been thoroughly divided, the flap, together with the posterior circumflex artery, can be easily separated by the point of the finger from the bone and joint, and drawn upwards and backwards so as to expose the head and tuberosities, without further use of the knife. The tendinous insertions of the capsular muscles, the long head of the biceps, and the capsule are next divided by cutting directly on the bone. Disarticulation is then accomplished, and the limb removed by dividing the remaining soft parts on the axillary aspect. In cases where the limb is very muscular, I dissect the skin and fat from the deltoid at the lower part, and then divide the muscular fibres higher up by a second incision, so as to avoid redundancy of muscular tissue.'

The operation by *antero-posterior* flaps, the anterior one being made by transfixion and the posterior by cutting from within outwards, is the one the writer, as a rule,

prefers. It closely resembles one of the methods advocated by Dupuytren. It is comparatively easy of performance, results in a shapely stump, and admits of greater facilities for freely opening the articulation than the other methods. On the other hand, it is not suitable in cases of malignant tumours of the arm, or in cases where, owing to extensive fracture, the leverage of the arm is not available to raise the head of the bone from the glenoid cavity.

The operator standing at the side of the patient, and the arm being raised and abducted, the point of a catlin is entered immediately below the posterior border and at the greatest prominence of the acromion, and the instrument, carried across the outer and anterior aspect of the head of the humerus, is made to emerge below and internal to the coracoid process. A flap involving the entire of the deltoid muscle, down to its insertion, is then made. This is then held back, and the capsule opened. The tendon of the biceps and the muscles attached to the great tuberosity are next divided, and the arm being rotated outwards, the subscapularis is divided at its insertion; the head of the bone can then be easily displaced forwards and the knife passed behind it, and the postero-internal flap, somewhat shorter than the anterior one, cut from behind forwards and downwards. In doing this the surgeon, when operating on the right side, can compress the vessels with his left hand before they are divided. On the left side this can be done by an assistant. The axillary vessels, the posterior circumflex artery, and smaller muscular branches, will require ligatures.

Mr. C. Heath describes a somewhat similar operation; but he prefers cutting the anterior flap from without inwards, as it gives, according to him, a 'larger and more satisfactory flap.' This method is clearly preferable in cases where the operation has to be done in proximity to any form of malignant growth. He describes the operation as being done by grasping the limb with his left hand, and bringing it across the chest; and he then 'enters the point of an amputation knife at the most prominent point or angle of the acromion process. With a sawing movement he marks out a flap of skin and deltoid muscle, taking nearly the entire muscle down to its insertion, and bringing the incision up to the coracoid process, at the same time drawing the arm away from the side. An assistant grasping the flap draws it up so as to expose the shoulder-joint, which is to be opened by one semicircular sweep of the knife laid on

close to the anatomical neck of the humerus, the bone being rotated by the left hand of the operator so as to bring the several parts of the capsule into view successively. The tendon of the biceps is divided with the capsule, and the head of the bone is then readily dislocated, so as to allow the blade of the knife to be passed behind it to form an inner flap.'

In controlling hæmorrhage during the performance of this amputation much assistance will be derived from compression of the subclavian artery against the first rib, which can be done by an assistant, either by means of digital or instrumental pressure.

Other modes of performing this operation might be mentioned: for example, the single square-shaped flap method of La Faye, the modification of it by Richeraud, who added an internal or inferior flap; the anterior semicircular flap method made by transfixion of Dupuytren; the antero-posterior flap method as performed by Desault and Lisfranc, as well as many others; but the procedures to which the writer has already directed attention appear to him to be sufficient to meet the cases requiring scapulo-humeral disarticulation.

WILLIAM STOKES.

SHOULDER-JOINT, Diseases of the.

A notable feature of the shoulder-joint is the very free movement which it allows in every direction; and one of the earliest and most valuable signs of disease of the articulation is an impairment of this free mobility.

The joint is best examined by standing behind the patient, and, while the scapula is firmly grasped near its neck and thus fixed by one hand, the lower end of the humerus is held by the other hand and can be moved in various directions. In the natural condition, this can be done without movement of the scapula upon the ribs, unless the arm be raised beyond a right angle with the trunk; but if the joint be inflamed, very little movement of the humerus, especially in the direction of raising the elbow, causes a corresponding alteration of the position of the scapula. Moreover, if the outline of the joint is carefully scanned both in front and from behind, and compared with the sound side, swelling may be detected by the alteration of shape and diminished distinctness of the surface-markings.

The shoulder is liable to all those forms of inflammatory disease, both acute and chronic, which are common to the articulations; but is much less frequently affected

than the other joints of corresponding size and importance.

Acute synovitis may be of traumatic, rheumatic, or pyæmic origin. There are the usual symptoms of swelling, heat, and pain, together with the restriction of movement above alluded to.

Rest, by bandaging the arm to the side, leeching, and the application of cold, are the appropriate remedies, and with the use of these the simpler forms of inflammation usually subside.

Pyæmic synovitis, which is not very uncommon in the shoulder, usually leads, however, to early suppuration. Matter points most commonly at the inner side of the deltoid, but may burrow along the intermuscular planes in other directions. Suppuration of this joint may also have its origin in an epiphysitis, or in an acute articular ostitis of the upper end of the humerus. It is a not uncommon seat of the syphilitic form of epiphysitis met with in young infants.

Suppuration here, as in other joints, calls for free incision and drainage; and, even when the destruction of the articular surfaces leads to extensive adhesions, the limb may be very useful, owing to the compensatory mobility of the scapula.

Chronic synovitis and pulpy degeneration must be treated by rest, counter-irritation, and attention to the constitutional condition in which it has its origin. Should the disease progress to ulceration of the cartilages, ankylosis may be regarded as a not unfavourable result. Slight adhesions, occurring without much destruction of the joint-surfaces, may be ruptured and good movement obtained; but if the adhesions or the diseased area are extensive, it is very difficult to prevent the recurrence of ankylosis, owing to movement taking place, involuntarily, rather by means of the scapula than at the shoulder-joint. In the scrofulous and other cases associated with great synovial thickening, the disease is apt to be slowly progressive and attended with troublesome suppuration; and in these, if the health is deteriorating, it is better to excise the head of the humerus, an operation which gives free access to the joint and allows of the removal of the diseased membrane, and which generally leaves a very useful limb.

The joint is a rather favourite seat of *osteo-arthritis*, recognisable by the usual symptoms of aching pain, crepitation, and impaired movement, alteration in the shape of the joint-surfaces, and fraying of the tendons which play over them. This disease,

occurring usually in the elderly whose tissues are degenerating, admits only of palliation, the most useful measures being friction, warmth, and aids to nutrition, such as cod-liver oil.

It may be well to mention here that the bursa beneath the deltoid is liable to both acute and chronic inflammation, giving rise to symptoms somewhat simulating those of disease of the shoulder-joint, but to be distinguished from it, chiefly, by the localisation of the swelling and pain, and the mobility of the humerus on the scapula.

J. WARRINGTON HAWARD.

SHOULDER-JOINT, Dislocations of the.—Dislocations of the upper extremity of the humerus are very frequent, owing to the shallow glenoid cavity, the loose capsule of the joint, and the exposed situation of the bone. The shoulder-joint is, indeed, far more frequently dislocated than any other joint in the body. The displacement is usually occasioned by a fall on the shoulder, sometimes by a fall on the elbow or hand, and, in rare instances, by such accidents as a jump from a height into water with the arms extended, falling through a trap-door, catching hold of a ladder to prevent falling, or a direct blow delivered on the upper end of the humerus. It has also been occasioned by muscular action. There are four regular dislocations of the shoulder-joint named from the position in which the head of the humerus is found—viz. (1) *subcoracoid*, which is by far the most common; (2) *subglenoid*, the next in frequency; (3) *subspinous*, which is uncommon; and (4) *subclavicular*, which is very rare. Besides these, certain anomalous dislocations have been described—viz. the *supracoracoid*, when the coracoid process has been broken and the head of the bone lies upon its base, and the *luxatio erecta*, a variety of the subglenoid. Dislocations of the shoulder are very uncommon under the age of fifteen, and much more frequent in males than in females, the proportion being about five to one.

Signs common to all forms.—There are certain signs of dislocation at the shoulder-joint which are common to all forms. These are—the angular appearance of the shoulder and depression beneath the acromion; the projection of the elbow from the side; the limitation of both voluntary and passive movements; the increased vertical measurement when a tape is carried through the axilla and over the shoulder (Callaway's test); inability to bring the elbow to the side when the hand is directed to the oppo-

site shoulder (Dugas's test); a ruler applied to the dislocated humerus may be made to touch the acromion and external condyle at the same time (Hamilton's test); finally, the rounded head of the humerus will be detected lying in some abnormal position.

THE SUBCORACOID.—This variety, which includes many cases that were described formerly as dislocations into the axilla, and some that were regarded as dislocations forward beneath the clavicle, has been proved, both by pathological demonstration and clinical observation, to be the most common form of displacement at the shoulder. It comprises both the intracoracoid and subcoracoid varieties of Malgaigne.

The *symptoms* which distinguish it are as follows:—The angular appearance of the shoulder is well marked; the elbow projects from the side, and is directed slightly backwards; the pectoral fold is widened and somewhat prominent; the head of the bone can be felt from the axilla and beneath the coracoid process, and its position can be made more evident in the axilla by raising the elbow; there is great pain from pressure on the nerves, and, usually, neither lengthening nor shortening, but the measurement from the tip of the acromion to the external condyle may vary to the extent of half an inch in either direction. Malgaigne described as subcoracoid only those in which the head of the humerus lay on the anterior edge of the glenoid cavity, and all those in which half or two-thirds of the head of the humerus lay to the inner side of the coracoid process he termed intracoracoid. The head of the humerus lies on the venter of the scapula beneath the subscapularis muscle. A *partial dislocation* in this direction was described by Cooper and Malgaigne, the head of the bone being supposed to partially escape on the edge of the glenoid cavity, without rupture or with slight tearing of the capsule. In Soden's case, believed to be of this nature, the escape of the biceps tendon from its groove was found to be the cause of the pain, fixation, and deformity, and in other cases this tendon has been found ruptured. In a case reported by Eve, in 1880, classed by him as complete, the capsule was found to have been lifted up with the periosteum from the front of the scapula, and a mark on the cartilage at the back of the head indicated the spot where this had lodged on the margin of the glenoid cavity.

THE SUBGLENOID variety comes next in point of frequency to the subcoracoid, with which it presents many points of similarity. The angular appearance of the

shoulder is more strongly marked than in that form, and the deltoid is rendered very tense. The elbow projects farther from the side, and the depression beneath the acromion is more evident, and is equally perceptible both in front of and behind the joint. There is lengthening of about an inch, and the fingers, placed in the axilla, readily detect the head of the humerus, which is lodged on the margin of the scapula between the long head of the triceps and the subscapularis. Lengthening is often apparent rather than real; the external condyle being approximated to the acromion by the abduction and loss of rotundity at the shoulder. The pectoral fold is much widened, but less prominent than in the subcoracoid variety, and, on pressure being made, an interval will be detected between the head of the bone and the coracoid process. Pain and numbness are felt from stretching of, and pressure on, the axillary nerves. This form of dislocation, if left unreduced, is liable to become converted into the subcoracoid, partly as the result of muscular action and partly from attempts to bring the elbow nearer to the side.

THE SUBSPINOUS is an uncommon form of dislocation, of which the writer has seen but two instances. It includes both the subacromial and subspinous varieties of Malgaigne. In stout subjects it is more liable to be overlooked than any other form, but in thin persons it is easily detected. The angular appearance of the shoulder, though present, is less marked than in any of the other varieties. The elbow is directed forwards and outwards, but not far from the chest-wall. There is usually no alteration in the length of the arm. The head of the bone may be felt in the subspinous fossa, where it lies below the acromion or spine and beneath the infraspinatus muscle. The anterior part of the shoulder is depressed, and the coracoid process is abnormally distinct. The subscapularis muscle is liable to be detached from its tuberosity by the force which produces the dislocation, and the infraspinatus is damaged by the head beneath it.

THE SUBCLAVICULAR is the rarest of the four regular dislocations of the shoulder-joint. In this form, the head of the bone is driven forwards past the coracoid process, and lies internal to it beneath the clavicle. The arm lies close to the chest-wall, and the elbow is directed outwards and backwards. The head of the bone is easily felt in its new position, and sometimes it becomes subcutaneous between the pectoralis major and deltoid. There is usually shorten-

ing of about an inch. The shaft of the humerus, but not the head, can be felt in the axilla, and the back of the shoulder is particularly flattened.

ANOMALOUS DISLOCATIONS.—*The Supra-coracoid*.—Malgaigne first described, under this term, the case of a man, aged sixty-eight, who fell from a load of faggots upon his shoulder and arm. The head projected upwards and forwards, lying on the coraco-acromial ligament, corresponding externally to the inner edge of the acromion and internally covering the coracoid process, whilst the deltoid was much thinned over it. Reduction, apparently not quite complete, was accomplished when seen two and a half months after the accident, by raising the elbow and pressing on the head. Holmes has since published an account of a dissection of a case in which the head had passed through the deltoid, had broken the coracoid process, and lay upon the stump.

The luxatio erecta is a curious and interesting variety of the subglenoid. Two cases have been described by Hulke and one by Cleland. The peculiarity of the dislocation is that the arm is raised and fixed in that position, the hand being above the head. Cleland's case was caused by a fall when using crutches; one of Hulke's by a fall through a trap-door; the other occurred in a sailor as the result of a fall from aloft, the arm being caught in the rigging.

THE TREATMENT of dislocations of the shoulder is to replace them without delay either by *extension* or *rotation*, after which the arm should be fixed for a fortnight or three weeks (according to the amount of damage present), and then gentle passive motion be commenced, followed by frictions, and perhaps galvanism, to restore the activity of the muscles.

The methods of reduction by extension are applicable to all forms, whilst the methods by rotation, which have lately come rather more into favour, are supposed to require some modification for the different dislocations.

THE EXTENSION METHODS.—*Extension with heel in the axilla* is perhaps the most certain of all the various methods, and is carried out as follows. The patient lies on his back upon a couch, and the surgeon, having uncovered his right foot, if for the right shoulder, thrusts his heel (not sole) into the axilla. Seizing the forearm with both hands at the wrist, he makes extension in the direction of the dislocated humerus, and then draws the arm across the patient's trunk. In this way the heel acts as a

fulcrum, by means of which the head of the humerus is forced outwards into its socket. If no anæsthetic is at hand, the aid of assistants may be required to overcome the resistance of the muscles. They may help by pulling on a jack-towel fixed by a clove-hitch to the arm above the elbow, and they should follow the motion inwards made by the surgeon.

Knee in the axilla (Astley Cooper's method).—The patient sits in a chair, and the surgeon, standing behind, places one foot on the edge of the chair, using the right knee for the left shoulder and *vice versa*. The dislocated humerus is drawn over the surgeon's knee and forced downwards, by which movement the head of the bone is thrown out into its place. A somewhat similar plan, originally described by Hippocrates and revived by Morgan, is that of drawing the arm over the back of a chair. Slinging the patient over the surgeon's shoulder by the dislocated arm, or over the step of a ladder, are both methods mentioned by Hippocrates. The weight of the patient's body would then be the extending force. Cooper mentions the case of a farmer, who learnt to reduce a frequently recurring dislocation by leaning over a gate and seizing the third or fourth bar on the other side. The fist, the forearm, and an iron knob have also been used in the axilla.

Upward extension (White's method).—A dislocation may be reduced by drawing the arm directly upwards, or upwards and backwards. The bone impinges first on the margin of the glenoid cavity, then against the acromion, and is thus partly raised and partly levered into place. If without assistance, the surgeon should stand behind the patient, and placing one hand on the shoulder should seize the wrist or elbow with the other, and draw the arm forcibly upwards and backwards. Another way, that of La Mothe, which gives more power, is to seat the patient on the floor; the surgeon then places one foot on the shoulder to make counter-extension, whilst with both hands he grasps the wrist and makes extension on the forearm. With two assistants, one should fix the shoulder and the other raise the arm; the surgeon is then free to manipulate the head of the bone into place. Upward extension is said to have been practised by Brunus as early as the thirteenth century.

Lateral extension may be made by placing the patient on a couch and fixing the trunk by a round towel, split to allow the arm to pass through. The arm may then be seized and extended at right angles

to the trunk. Another way suggested by Gordon is to lay the patient on his sound side, then to raise the dislocated arm at a right angle with one hand, whilst the other is used to press on the head of the bone; or, assistants may attempt to lift the patient by the arm, whilst the surgeon uses both his hands in manipulating the dislocated head of the humerus. A different method of employing lateral extension has somewhat recently been advocated by Kelly, and appears to be efficient if not elegant. The patient lies on his back at the edge of a couch, with his arm at right angles to the trunk. The surgeon presses his hip into the patient's axilla, and folding the arm around his pelvis holds it by the wrist against the unengaged side of his pelvis, then by rotating his body outwards he makes extension and pressure on the arm, which effect the reduction.

Lateral extension may be also made by pressing the foot against the patient's chest-wall for counter-extension, whilst pulling the arm directly outwards; or, as recommended by Nathan Smith, the counter-extension may be made from the opposite wrist.

When *pulleys* are used for unreduced dislocation (a method now seldom employed), extension is usually made in the same direction, the trunk of the patient being fixed by a split towel, and the girth for the pulleys being applied to the arm above the elbow. Skey's iron knob had branches to project in front and behind the axilla, by which the shoulder was fixed, so that the pulleys might act in the same direction as when employing the heel in the axilla.

THE ROTATION METHODS, like those by extension, are very ancient, but are constantly being re-invented with slight modifications by modern writers. Hippocrates describes reduction by flexing the elbow, drawing it back, and rotating the arm. It is somewhat curious to note that different authors advise rotation in opposite directions for the same dislocation, and their efforts appear to be followed by equal success. It is evident the mechanism of reduction must differ in the two cases. Most authors now agree in advising *rotation inwards* for the common forward dislocations and rotation outwards for the dorsal dislocation. Supposing the ordinary sub-coracoid dislocation to have occurred, the capsule will be ruptured at the anterior and lower part, whilst the upper and back part, with which the muscles of the great tuberosity are incorporated, will be very tense. Raising the arm and rotating it inwards

will cause the head to travel along the edge of the glenoid cavity and slip over as in reduction by rotation at the hip. Much assistance will be given by, at the same time, pressing the head outwards.

Kocher's method consists in flexing the forearm to a right angle, pressing the elbow towards the side, rotating the arm outwards till resistance is experienced, then raising the arm and rotating it inwards so that the hand drops over the opposite shoulder. *H. H. Smith's method* differs little from this and was published earlier. He directs that the forearm should be flexed and raised from the side; secondly, the humerus should be rotated upwards and outwards; and thirdly, this movement should be reversed, the humerus being rotated downwards and inwards, and the elbow carried to the side. Malgaigne also, following the Hippocratic method of rotating inwards, found that he could reduce nearly every subcoracoid case on the cadaver by this means.

Rotation outwards would seem to be a more recent practice, and to have commenced with Syme, whose method was to fix the acromion with one hand, then flex the forearm to a right angle and draw the elbow suddenly back, at the same time rotating the arm outwards. Professor Gunn, quite recently, has advised rotation outwards for the reduction of dislocation forwards, believing it right to relax the upper and back part of the capsule. He advises that an assistant should fix the shoulder, whilst the surgeon raises the arm to a horizontal position, carries it backwards, rotates it outwards, and draws it into position. For similar reasons, he advises that for subspinous dislocations the arm should be raised and rotated inwards.

The writer has found the following method very efficient. Standing behind the patient, he seizes the forearm just below the elbow, flexes it, raises the arm to a right angle and rotates it outwards; then, placing his disengaged fist in the axilla, he makes circumduction outwards and brings the elbow backwards and downwards to the side.

R. CLEMENT LUCAS.

SHOULDER-JOINT, Excision of the.
See JOINTS, Excision of.

SICK-ROOM, Management of the.—In this short article it is intended merely to sketch the duties of the surgeon and nurse as regards nursing surgical patients. The ward of a hospital is, or ought to be, so placed, apportioned, and hygienically arranged, that

it needs not the strict surveillance, in preparation and choice, that a room in a private house for the reception of the sick necessitates. When selecting a sick-room, or a room for operation and subsequent rest in a private house, look after the following points:—(1) Get a room on the top floor, or, at any rate, not lower than the second. (2) The room window should look south-erly, light and sun-penetrated air being life itself to the patient. (3) Choose as quiet a room as possible. (4) A room of a good size is essential. By that is meant a room of such a size that it can be ventilated without draughts.

The Dimensions of a Room in cubic feet can be obtained by measuring, and multiplying the length by the breadth by the height, in feet. Supposing these were 15 by 10 by 7, the dimensions of such a room would be 1,050 in cubic feet. This is the smallest room any sick person should be put into. In a hospital, each bed should be allowed not less than 100 square feet of superficial area, and a cubic space of not less than 1,000 cubic feet.

To prepare a Room to receive a Patient.—Remove from the room every piece of furniture and clothing which can be dispensed with. Remove the carpets; empty the cupboards and chest of drawers; remove trunks, boxes from below the bed, &c., as these occupy space and so diminish the breathing air available for the patient. Dust the room out, not by flapping the dust from the mantelpiece on to the floor, but by carefully wiping the walls with a damp cloth, cleaning out the cupboards, pulling out each drawer and inverting it. When the dust has settled upon the floor, use a broom with a piece of moist flannel tied over it—this is the means to be employed always in a sick-room when the patient is *in* the room: in this way wiping and dusting are done without causing inconvenience or dampness. All dust from the sick-room floor is to be burned in the fire in the sick-room itself. Remember that below the bed, the chest of drawers, and the basin-stand dust lies unseen, but is not the less dangerous, and requires removal if the room is to be kept *sweet*. The floor is then washed, the metal bedstead wiped, the fire lit, the window opened widely, and the room left for a while. When the floor is dry, put the bedstead in its place—which ought to be against a partition wall, between the door and window, so as to be out of the air passing towards the fireplace from each of these.

The bedstead ought to be of metal, six feet three inches long, and three feet six

inches wide. Rheocline springs or a wire mattress may be used, and a hair mattress placed thereon; but in case of fractures these luxuries must be dispensed with, and fracture-boards used instead — i.e. deal boards, perforated with many holes, cut about one foot six inches in width, and in length equal to the breadth of the bed. Four such boards would ordinarily be required. A woven wire mattress with a thin hair mattress laid thereon is apt to be very cold. If two mattresses are used, the lower may be of straw; the straw must be burnt afterwards. If much discharge is expected, place a piece of macintosh over the mattress; instead, a blanket is used by some, but it is apt to act like a poultice and cause bed-sores.

Over these a sheet is now laid and tucked tightly beneath the upper mattress, if two are used. Do not wrap the bolster up in the under-sheet. It is the nurse's bounden duty to be continually pulling the under-sheet straight: this she cannot do without displacing the bolster and patient down the bed, if the bolster is wrapped up in the under-sheet. Complete the covering by an upper-sheet, blankets according to the season of the year, and a light chintz quilt. Avoid heavy counterpanes sweeping the floor on either side; exclude also a valance and curtains.

The Fire.—Place coals on the fire by the hand, to avoid noise. Coals are laid on a piece of canvas or paper on the floor; a large glove is hung, say, on the bell-pull above, and, slipping the hand into that, lift the coals. Dispense with a coal-scuttle and all fire-irons, except a poker. Should the room be full of smoke, cover the patient's head with the sheet, open the door and window wide; the room will be thereby cleared in a minute or two. Should the chimney require sweeping, have it swept, but previously put an extra blanket over the patient and a hot bottle in bed. It is the putting out the fire, especially in cold weather, wherein the danger lies—not in the smell of soot. The temperature of the room ought, in surgical cases, to be kept about 60° Fahr.; it should never be allowed to fall below 58°. When lung-troubles arise, the temperature ought to be kept between 65° and 70°. Hang the thermometer at the head of the bed close to the patient.

Ventilation.—In a room of 1,000 cubic feet, each person requires the air changed thrice per hour. Fresh air comes from the window, not from the door. The air is to be admitted in such a way that it has an upward direction as it enters. In the case

of an ordinary two-sash window, the plan recommended by Bird is the most simple—throw up the lower sash, and, placing a board along the gap made below, shut the lower sash down upon it. By this means air can only enter by the centre of the window, when it is sent upwards to the ceiling, where, meeting the hot air of the room, it is warmed and falls gently like spray from a fountain on the patient, and not as a torrent, which it would do were the top of the window opened. The board used may vary from one to six inches in depth, according to the season of the year.

To Wash a Patient in Bed.—Use tepid water, soap, and a flannel cloth. Place a towel on the pillow to protect it; wash the face, neck, and hair of a boy or man daily, wash a woman's hair once a week. Now, bring an arm from beneath the bedclothes, place a towel lengthwise below it to protect the sheets, and tuck the bedclothes round the shoulder; wash and dry the limb, and put it back beneath the clothes. Repeat this process with all the limbs *seriatim*. To wash the *front of the body* pull the night-dress up, and the bedclothes down; tuck a towel on either side of the body so as to protect the sheet; wash and dry the part exposed. To wash the *back*, turn the patient on one side, thus: standing on the floor, the nurse places one hand behind the patient's far-off shoulder, the other behind the far-off hip; if the patient is able to do so he ought to place his arms around the nurse's neck. The nurse can then turn the patient gently over upon the side; bare the back, tuck a towel below to catch the water, wash and dry the parts, and replace the patient. A patient is thus washed without more than a small part of the body being exposed at a time.

To make a Bed without moving the patient from the horizontal position.—Without removing the bedclothes, glide the patient to the edge of the bed next the fire. Place three or four bedroom chairs along that side of the bed, with the backs next the fire. On the chairs lay a bolster or pillows until this temporary couch is on a level with the mattress. The nurse, reaching over the backs of the chairs, now glides the patient, who can very rarely assist her, on to the improvised bed, where, covered over with blankets or a rug, the patient lies whilst the bed is being made. If the nurse even have two beds at her command, she will not, working by herself, find it so easy to move a patient on to the spare bed as by the method given, if the horizontal position is to be maintained. Do not use a sofa

or couch instead of the chairs. In making the bed, throw the blankets one by one, not all in a heap, over chairs, &c., in the room; or, if allowable, on the stair-rail outside the bedroom door. Turn the mattress, or hold it up, to let the air get at its under surface. When the bed is made up, retain around the patient the blanket in which he is enveloped, and glide him back into bed; remove the blanket around him when he is warm in bed.

To change Sheets.—Warm and ‘air’ the clean sheet; roll it up lengthwise; lay it thus rolled on one side, say the right, of the bed. Pull the soiled under-sheet from below the bolster, roll it up lengthwise, and unroll the clean sheet, up to the patient’s right side. The nurse goes round to the left side of the bed, turns the patient on his left side, as directed for washing, and continues the process of rolling up and unrolling the sheets up to the patient’s left side. Then, replacing the patient, he lies on the clean sheet, and the two appearing at his left side, the soiled is removed and the clean one tucked in. The sheet can also be changed by rolling or dragging it down from the top to the bottom of the bed. This is easily done when two are engaged in it, or when the patient can sit up in bed, but otherwise it is a rude proceeding. It is necessary, however, in a case of fractured leg, when the patient dare not be turned on the side.

Soiled Linen must be immediately removed from the sick room, placed in a jar outside the room, and, if non-infectious, sent to the laundry immediately; if infectious, boiling water is poured over it and a solution of 1 in 80 of carbolic acid, until the linen is covered and a strong odour of carbolic is smelt. Filthy *bandages* are to be burned immediately, it may be in the fire of the sick room. Bandages used for fixing splints may, after disinfection by boiling in soft soap and soda, be used again.

Utensils.—Cleanliness of the utensils in the room, whether in sickness or health, is a necessary axiom. Carbolic-acid solution (1 in 60) may be placed in the wash-hand-basin, in the bed-pan, in the chamber-utensil, the bleeding bowl, the dressing basin, &c., or carbolic powder may be sprinkled in them instead. This provides for the presence of a disinfectant in the room, which, by its decided odour, satisfactorily asserts its presence and activity. All slops must be removed at once, carried to the water-closet (or cesspool) and there emptied. The utensil should be there rinsed out, dried, have carbolic powder sprinkled

therein, and not be brought into the sick-room until it is wanted. Every pail and bed-pan used should be of white glazed earthenware, and have a tight-fitting lid. Place no utensil under the bed, not even when dried and disinfected; it cannot get sweet there—it must have a free circulation of air around it.

Feeding Patients.—It is needless to tell medical men to be careful about the time of feeding, the kind of food to be given, the method of its preparation, the needful time for changing it, &c. These are the first duties and requirements of practitioners; but how to administer the food few can tell the mother, sister, or wife of the patient—the nurse for the time being. When fluid foods, such as beef-tea and milk, are being given, attend to the following points:—A drinking cup may be useful, but see that its spout is wide, otherwise the patient gets tired of sipping the insipid fluids: he prefers a good mouthful, to get the feeding process over quickly. To give beef-tea, say at night, when the patient is asleep, have the beef-tea in a large warmed cup or jug, set on a small table by the bedside. The nurse then, without speaking or whispering—and this is the difficult thing to do—slips her left hand and forearm behind the patient’s pillow and raises the head slightly. Then she can—if the bed is narrow, as it ought to be—reach with the other hand the basin and convey the food to the patient’s mouth by a spoon. Use a large spoon—a tablespoon—and put little in it, otherwise the beef-tea will be spilt on the sheets, blankets, night-dress, or beard. A convalescent patient should be fed with dainty bits, under, rather than up to, his capacity and appetite.

The Nurse must wear a dress which causes no noise as she moves about, and which is pleasant to the patient to touch. She should have no pins about her, whereby to scratch the patient; she must be quiet and quick, resolute and gentle, cheerful, but expressionless in regard to untoward symptoms. She has to observe order and punctuality; and preserve not only cleanliness but sweetness in her apartment, in her patient, and in her person; but above all has she to cultivate gentleness and cheerfulness of behaviour towards her patient.

It is essential that a nurse’s health be preserved by securing her rest in bed for at least six hours daily; and she ought, except in cases of great emergency, to get a daily walk for an hour. A nurse’s meals should not be taken in the sick-room, where the patient must necessarily smell the cook-

ing, and thereby get disgusted for food himself; and the nurse ought to be allowed plenty of time for her meals, which should be served as punctually as those of the patient.

JAMES CANTLIE.

SIGAULT'S OPERATION. See SYM-
PHYSIOTOMY.

SINUS.—A *sinus* is an unnatural suppurating canal which opens externally. When it communicates internally with one of the normal canals or cavities of the body, it is usually termed a *fistula*.

The primary *causes* are wounds, abscesses, or suppuration in deep-seated structures, such as bone or periosteum, or in cavities, such as joints, serous sacs, or the sheaths of tendons. The secondary causes are—

(1) *The presence of a foreign body*, introduced from without—e.g. a bullet or a piece of glass, or arising from inflammatory processes within—e.g. a sequestrum, the fang of a dead tooth, or a caseous gland. In this class may also be placed the discharges from ulcerating surfaces, such as those of a diseased joint. Of the same nature is the irritation set up by the escape of secretions or excretions through an unnatural opening, but the form of sinus which gives passage to such materials is described under the head of FISTULA IN ANO.

(2) *The size and position of the external aperture.*—If this be too small, or if it be some distance above the lowest part of the abscess-cavity, there will be an obstacle to the free discharge of pus, and the walls of the cavity will be unable to contract and coalesce. This may be due, in a wound, to the more rapid healing of the superficial tissues, and, in the case of an abscess or deep suppuration, to the difficulty of penetrating the strong fasciæ which lie beneath the integuments.

(3) *Want of rest*—e.g. where muscular movements prevent the walls of the cavity from uniting. Hilton, in his work *On Rest and Pain*, has given numerous instances of sinuses kept up by the contractions of the occipito-frontalis and other muscles. A frequent example is that form of sinus called a blind external fistula, in which the proximity of the sphincter ani prevents the healing of an anal abscess.

(4) *Want of apposition* of the sides of the cavity from which the pus is discharged. This is often exemplified in the slow repair of the sinuses which follow the removal of a sequestrum, or the opening of the pleural sac in empyema. It is probable

also that, after extensive destruction of the fatty tissue in the ischio-rectal fossa by suppuration, this may be one of the causes which prevent the closure of the resulting sinuses.

(5) *A feeble condition of health.*—This may be due to some inherent defect in the constitution, such as the scrofulous diathesis, in which the reparative lymph is so apt to undergo caseous changes; or it may be the result of loss of blood and prolonged suppuration, as in the debility which sometimes follows an amputation.

(6) *Local deficiency in reparative power.* The hard and evascular condition of the parts from the long continuance of a sinus may prevent its healing, even when the original cause—e.g. a sequestrum or foreign body—has been removed; or there may be some local influence, such as the enfeebled circulation from paralysis, or the congestion from a dependent position, which may tend to retard recovery.

Condition of the Parts.—The orifice of the sinus may vary in size from a hardly visible puncture to a large ulcer. It is sometimes concealed by a thin scab; at other times, especially when the parts are vigorous and vascular, it is indicated by a prominent mass of florid granulations. Where it has existed for some time, if it lead to deep structures such as bone, there will be some depression of the adjacent skin, at the bottom of which the granulations projecting from the aperture of the sinus will be seen, like the button upon a chair-cushion. The course of a sinus may be straight or tortuous. Its calibre may be uniformly narrow, or it may be varied by wide dilatations. The walls of an old sinus will be hard, pale, and insensitive, and they will not bleed readily when irritated. Their interior is sometimes so smooth as to resemble mucous membrane. In more recent cases they are covered with soft, sensitive granulations, and bleed readily. The adjacent structures are infiltrated with more or less developed fibrinous deposit, or even with bone, as in a *cloaca*, which is the part of a sinus passing through ossifying periosteum. The pus which exudes from a sinus is usually thin and watery, and it frequently contains fatty or calcareous débris from the deeper parts.

The *treatment* of sinuses constitutes a large part of the practice of surgery, but it is only possible to mention here the principles upon which it rests, and a few of the methods by which they are applied.

After obtaining a history of their formation, and observing the condition of the

apertures and the adjacent parts, it is necessary to examine their direction and extent by means of a probe, which may be straight, or, if the passage should prove tortuous, it should be slightly bent near the extremity. In the case of multiple sinuses, it may be desirable to use an injection to ascertain whether they are all in communication with one another. The presence of any hard foreign body or sequestrum will usually be easy to recognise, and at the same time an opinion may be formed as to the firmness with which it is fixed in the tissues. By an appropriate operation such a body may be removed, and the sinuses will usually heal up at once. If the opening be small, or not sufficiently dependent, it will be necessary to increase its size or to make a fresh opening in a more favourable position. Where this is not possible, as in the case of an iliac abscess penetrating deeply into the pelvis, the same end may be obtained by other means, such as keeping the patient lying in the prone position. An india-rubber drainage-tube should also be introduced, to ensure that there shall be no obstruction to the emptying of the abscess-cavity.

When want of rest or apposition is a hindrance to recovery, the parts may be kept quiet and in contact by the pressure of carefully applied compresses or strapping. If the sinuses are in the lower extremity, the patient should be kept in bed, and some form of splint or plaster of Paris apparatus may be necessary to ensure perfect rest. In other cases, the division of an adjacent muscle or tendon may be called for. The closure of the pleural cavity in empyema has sometimes been facilitated by the removal of portions of the ribs. Where the debility of the patient is the cause of delay, nourishing diet, cod-liver oil, iron or quinine, and a moderate allowance of stimulants will be required, and a change to the country or the seaside will be beneficial. The local weakness which prevents healthy repair may be combated by stimulating injections of iodoform dissolved in ether, or of sulphate of zinc lotion (five grains to the ounce of water).

In many cases, however, these methods will fail, especially when long-standing disease has induced a callous condition of the granulations. It will then be necessary to carefully slit up and explore the sinuses. This should generally be done under an anæsthetic, as to do it thoroughly necessitates often a tedious and painful operation. At the same time we should search for and remove any material which may be

keeping up the discharge. Thus, all caseous masses of gland-tissue and the carious surfaces of bones should be scooped out, and the degenerated granulation-tissue should be scraped from the interior of the sinuses; the thin, livid, undermined skin around their orifices should also be clipped off with the scissors. A large wound will thus be formed, which should be stuffed with lint or carbolic gauze, to prevent the primary union of the divided parts. In a few days, a granulating surface will be developed, and cicatrization will usually proceed rapidly, for the extensive margin of healthy skin will aid materially the process of repair. In some cases it may be expedient to make use of the elastic ligature for the division of the soft parts covering a sinus, so as to avoid all risk of hæmorrhage.

N. DAVIES-COLLEY.

SKIN-DISEASES.—During the last half-century great progress has been made in the scientific study of skin-diseases. This has not been confined to any one country, but has extended over the greater part of Europe and North America, and at the present time there is a general agreement amongst dermatologists on all the more important points connected with the subject. It is only necessary to look over the leading text-books in use in England, Germany, and America to see how close this agreement is. French literature does not follow in exactly the same path, but the differences, even there, are not many or important. This general agreement has led to the adoption of a uniform system of nomenclature, which until lately was almost impossible. This system has no doubt grown up gradually from the time of Willan, but has been much modified and improved by recent writers and observers. The process of improvement will continue, but the field for change has been greatly narrowed. The nomenclature lately published by the London College of Physicians fairly represents the one in general use, though some of the very rare forms of disease have been wisely omitted. Another fact of practical importance, which recent observations have tended to establish is, that skin-diseases cannot be looked upon as mere eruptions, but must be regarded, with few exceptions, as definite diseases, which do not change from one disease into another because there is a change in the form of the eruption, nor have they more tendency to become mixed than is the case with other diseases. Lastly, a knowledge of their morbid anatomy is almost entirely the result of recent

observations. The classification of skin-diseases, though interesting as an exercise or study, is of very little practical value. The following list is chiefly intended as a key for facilitating reference, and does not pretend to strict scientific accuracy in grouping.

Skin-diseases may be divided into three groups:—

I. Eruptions of an inflammatory character.

II. Diseases of nutrition unattended with inflammation.

III. Morbid growths of the skin.

The first of these includes all *eruptions* properly so called, and therefore forms a large group, which, for convenience, may be divided into two sub-groups:—A. Moist eruptions; B. Dry eruptions. The other groups, being smaller, require no subdivision.

The three *chief* groups of skin-diseases are quite legitimate divisions; but the subdivision of Group I. is simply a matter of convenience for purposes of diagnosis. Group I. comprises the skin-diseases attended with *inflammatory* eruptions. The degree of inflammation varies much, not only in different diseases, but even in varieties of the same disease; its presence, however, forms a bond of union, and, as a consequence, all eruptions belonging to this group are more or less associated with subjective sensations of pain, burning, or itching—a fact which is of some diagnostic value.

If, then, the reader has before him a moist eruption, and is in doubt as to its nature, he should first refer to Sub-group A, and having looked down the list until he comes to the disease which seems most nearly to correspond, he should then refer to the detailed account of the disease given in the body of this work. If the eruption is a dry one, he should refer in the same way to Sub-group B.

The moist eruptions which make up Sub-group A are the following:—Eczema, erythema with vesicles (i.e. hydroa), herpes, hyperidrosis, impetigo, pemphigus, phthiriasis, prurigo, scabies, syphilides (moist), zoster. The distinctive diagnostic features of each disease are given below in the following order:—(1) Character of the eruption; (2) subjective sensations; (3) characteristic (but not the only) regions affected.

1. *Eczema*.—Redness and swelling, with eruption of vesicles; surface denuded of epidermis, discharging gummy fluid; pain and itching; flexor surfaces and scalp; symmetrical.

2. *Erythema with Vesicles* (Hydroa).—Wheal-like spots of erythema with central vesicle or small bleb; itching and pain; backs of hands, forearms, lower lip and mouth; symmetrical.

3. *Herpes* (H. catarrhal.).—Discrete vesicles in small groups on red skin; not itching, pain slight; lips and prepuce; lasts about a week.

4. *Hyperidrosis* (including Bromidrosis). The excessive sweating leads to a maceration of cuticle and artificial eczema; hands and feet.

5. *Impetigo* (Impetigo Contagiosa).—Vesico-pustular; thick, discrete, yellowish scabs, covering superficial sores; occiput, corners of mouth and nose; unsymmetrical; easily inoculated by finger-nails; lymphatic glands in neighbourhood enlarge quickly.

6. *Pemphigus*.—Crops of large blebs; pain and itching; skin generally and mucous membrane of bowels; constitutional symptoms severe; fatal in old people.

7. *Phthiriasis*.—Papules, excoriations and bleeding points from scratching; itching intense without pain; parts covered by clothes, especially back.

8. *Prurigo*.—Large papules mixed with an eruption of eczema, pigmentation and enlarged lymphatic glands; itching intense; extensor surfaces, especially lower limbs; symmetrical; begins in early life; very chronic.

9. *Scabies*.—Papules and vesicles discrete, with marks like pin-scratches; itching severe at night, without pain; flexor surface of wrist and between the fingers, lower part of abdomen and buttocks, also feet in infants.

10. *Syphilides* (Moist).—These simulate ordinary skin-diseases, such as eczema or impetigo, but are not common forms of syphilitic eruption, and are always associated with other symptoms of syphilis. See SYPHILIS.

11. *Zoster* (Herpes Zoster).—Large discrete vesicles in groups on red base; unsymmetrical; neuralgic pains before and after eruption; follows course of intercostal or other nerves; duration of eruption about a fortnight.

The dry eruptions (pimpley or scaly) which make up Sub-group B are the following:—Acne, acne rosacea, eczema (dry), erythema (nodosum and papulatum), lichen, psoriasis, steatorrhœa, sycosis, syphilides, urticaria.

1. *Acne*.—Pimples in young adults; not itching, slight pain; face and back; very chronic.

2. *Acne Rosacea*.—Red patches and pimples in middle-aged women; sensations of burning; face only; symmetrical.

3. *Eczema* (Dry).—Red, slightly scaly patches; great itching, no pain; flexor surfaces.

4. *Erythema* (Nodosum).—Raised, oval, red, bruise-like patches, painful and tender when touched; not itching; symmetrical; front of the legs; often associated with rheumatic pains. *E. papulatum*, much smaller spots affecting backs of hands and forearms.

5. *Lichen Planus*.—Large, raised, dark red, flat-topped, shining papules, leaving brown pigmentation; itching intense; flexor surface of wrist and front of forearm; symmetrical.

6. *Psoriasis*.—Raised patches covered with silvery white scales, healing first in centre; no pain; itching very slight in the young, often severe in the middle-aged; extensor surfaces of limbs, especially elbows and knees; symmetrical; very chronic and recurrent.

7. *Steatorrhæa* (Seborrhœa).—Greasy, scaly eruption; itching; scalp and eyebrows; partial loss of hair; often called pityriasis capitis.

8. *Sycosis*.—Red patches and acne-like pimples, with a hair passing through each; confined to the hairy parts of the face in males; very chronic. In this disease there is sometimes slight exudation from the hair-follicles. This, however, is not an essential feature, and the general absence of it is one of the distinctions between sycosis and pustular eczema of the hairy parts of the face.

9. *Syphilides* (dry eruptions) resemble the scaly and papular non-syphilitic eruptions, but are more mixed in character (polymorphic), with little or no itching and more pigmentation; they are associated with other symptoms of syphilis. See SYPHILIS.

10. *Urticaria* (Nettlerash).—Wheals and red raised patches; stinging sensation and intense itching.

II. DISEASES OF NUTRITION. — These are *non-inflammatory*, and are therefore free from those subjective sensations which are chiefly due to inflammation, such as pain, burning, and itching. This serves as a rough and ready distinction from the diseases of Group I. The only exception to this rule is *tinea tonsurans* (ringworm), which is often associated with very slight inflammation and itching, but the vegetable parasite interferes, in such a marked degree, with the nutrition and growth of the hair,

that this forms a much more distinctive character of the disease than the slight and almost accidental inflammation set up. The following are the diseases which belong to this group: *Alopœcia areata*, *chloasma*, *favus*, *ichthyosis*, *keratosis pilaris*, *leucoderma*, *lichen scrofulosus*, *striæ atrophicæ*, *tinea tonsurans*, *tinea versicolor*.

The distinctive diagnostic characters of each are given below.

1. *Alopœcia Arcata*.—Smooth, roundish, bald patches surrounded by luxuriant hair; scalp, especially occiput and hairy parts of the face; hair falls rapidly with atrophied roots.

2. *Chloasma*.—Yellowish-brown pigment-patches; forehead and neck.

3. *Favus*.—Cupped, sulphur-coloured crusts and dry scaly patches; scalp; almost unknown in England; parasitic.

4. *Ichthyosis*.—A dry and scaly condition of skin, which has a dirty appearance; the cuticle is apt to crack, so as to form small lozenge-shaped plates. Body generally, but most marked about the knees and ankles; the disease is congenital, but shows little during infancy.

5. *Keratosis Pilaris* (Lichen Pilaris).—Papules with a hair passing through each; resembles exaggerated persistent 'goose skin'; outer surface of limbs, especially upper arms; symmetrical.

6. *Leucoderma*.—White patches of skin, surrounded by healthy skin often browner than usual.

7. *Lichen Scrofulosus*.—More or less rounded patches of minute pale pimples; no itching. Trunk, scrofulous children.

8. *Striæ Atrophicæ* (Linear Atrophy).—Glistening bluish-white stripes, resembling those met with in the abdomen of women shortly after parturition.

9. *Tinea Tonsurans* (Ringworm).—Roundish, scurfy, partially bald patches, with short, stumpy, broken hairs; slight itching; scalp; almost confined to children under sixteen years of age; parasitic.

10. *Tinea* or *Pityriasis Versicolor*.—Yellowish patches with a tendency to symmetry, almost confined to the trunk. Met with in adults who perspire freely; parasitic.

III. MORBID GROWTHS. — This group includes hypertrophic as well as other growths of the skin. As a rule, growths of the skin compared with eruptions are of slow development. Inflammatory eruptions occupy days or weeks, and morbid growths months or years in development. Morbid growths are firm solid structures, more or less raised above the surface of the

skin, and for the most part have an unsymmetrical distribution. The only exception to this is met with in lupus erythematosus, which cannot be described as a solid structure, and belongs at least as much to inflammatory eruptions as to morbid growths. The following diseases are included in this group: Acrochordon, fibroma, keloid, lupus vulgaris, lupus erythematosus, moles, molluscum contagiosum, nævus, rodent ulcer, scleroderma, syphilitic growths, warts, xanthelasma. The diagnostic characters of these diseases are given below.

1. *Acrochordon*. — Very small cylindrical or cordlike outgrowths; loose skin of neck.

2. *Fibroma*. (Molluscum Fibrosum). Small fibrous tumours; usual size from a pea to a filbert; often pedunculated, often congenital.

3. *Keloid*. — A fibrous growth which develops in scars; smooth and shining, and often vascular; pain or itching.

4. *Lupus Vulgaris*. — Reddish-brown tubercles and raised patches of new tissue, which have a strong tendency to ulcerate and form open sores; leaves scars. Face and mucous membrane of nose and mouth. Unsymmetrical; first appears between the ages of two and fifteen.

5. *Lupus Erythematosus*. — Red patches very little raised; often symmetrical; no ulceration, but leaves superficial scars; itching and burning; face, scalp, and ears. Does not appear before puberty.

6. *Moles*. — Congenital malformation of patches of skin, with more or less hypertrophy of the connective tissue, pigment, and hair.

7. *Molluscum Contagiosum*. — Small, round, umbilicated, translucent tumours; usual size from pin's-head to pea; face and neck; contagious.

8. *Nævus* is essentially a congenital vascular growth of the skin.

9. *Rodent Ulcer*. — Small translucent nodule, yellowish colour, streaked with minute vessels, of very slow development; ultimately ulcerates and spreads, destroying tissues. Face above the lower jaw, especially sides of nose. Rarely met with in those under thirty.

10. *Scleroderma* (Morphœa). — A fibrous growth in the form of patches of a pale yellowish-white and wax-like or ivory appearance, often with a pink areola of vessels; very little raised above the skin; pain and itching; often followed by atrophy of skin; very chronic.

11. *Syphilitic growths* are generally multiple, and develop more rapidly than

most other growths of the skin; have a strong tendency to ulcerate, and are associated with other symptoms of syphilis. See SYPHILIS.

12. *Warts*. — Small rounded raised growths, formed by hypertrophied papillæ, flat granular top; usual size, split pea. Hands in children, scalp in adults.

13. *Xanthelasma* (Xanthoma). — Sharply defined small bright yellow patches, resembling chamois leather; very slightly raised; upper eyelid and round the inner canthus; painless; seen chiefly in elderly people.

ROBERT LIVEING.

SKIN-GRAFTING. See GRAFTING.

SKULL, Deformities of the. See MENINGOCELE; RICKETS.

SKULL, Diseases of Bones of the. See CRANIOTABES.

SKULL, Fracture of the. — *Preliminary Observations*. — The anatomical relations of the skull and its coverings, relatively to the age of the patient, are important considerations in the determination of fractures of the cranium. The free movement of the head upon the spine, and the density and mobility of the scalp, tend to protect the skull by diminishing the impact of force from without. The construction of the vault in arch or dome shape increases its strength and power of resistance. The consistence and physical properties of the cranial bones, the intimacy of their union with one another, and the condition of the sutures vary greatly according to age. In infants, a complete fracture of the skull is rarely seen, on account of the elasticity of the unossified bones, and the gaps filled with membrane which exist between them. The consistence of the bones in young children enables them (practically) to bend rather than break, and indentations or bulges, with the convexity inwards, are formed. The same pliability is evinced in the gradual rectification of the deformity by the force of the brain's impulse. The relative consistence of the bones, in children and old people, has been aptly compared to sheet tin and earthenware. In adult life, and especially during the period of adolescence, the skull is still so fibrous as to permit of cuts being made into it without the production of fracture. Not only can instruments, and such materials as glass and earthenware, be driven into and sometimes through the skull by clean cuts, but by a sharp instrument portions may be cut or cleanly

scooped out. In early life, the lack of union between the bones is of value in distributing the pressure of a blow upon any given point, and the sutural membrane, at this period of considerable thickness, acts as a kind of buffer, which interrupts the force. In adult life this membrane disappears, and the sutures begin to be obliterated at about forty years of age. This complete union of the bones is first met with in the sagittal suture, and last in the squamous. The skulls of old people have lost much of their fibrous tissue, and have become more earthy and brittle.

The skull may be said to be made up of a series of arches, all resting upon and radiating from the basilar process. If these arches were of a definite and calculable thickness and consistence, and occurred with anything like uniformity in the human species, then, given the force applied to the cranium, it would be easy to estimate the exact position, the course, and the extent of the fracture. But as these factors are not constant, and as, besides, there are in the cranial bones a series of buttresses upon which the force is broken, interrupted, and distributed, it is impossible to arrive at a precise and accurate conclusion as to the course and extent of the fracture in the great majority of instances. While this is so, the nature of the injury and its mode of production assist in determining approximately the extent and character of the lesion. It is of use to know the usual manner in which force is transmitted through the various parts of the skull, as it explains how fractures are resisted in certain points, and shows how and where indirect fractures are likely to occur. It may be premised that a blow from a sharp instrument generally causes local lesion, while severe impact with a blunt body is apt to lead to a general injury.

When a blow is received on the vertex, the upper borders of the two parietals tend to be driven inwards, while their lower borders are forced outwards, this outward tendency being resisted by the squamous and the great wing of the sphenoid. It is supposed that the facial pain, often felt after such blows, may be explained by the force being transmitted from the squamous to the zygomatic arch, and so to the malar and frontal bones. A blow from a hard body may produce a fracture of the vertex, which may end there if the force is thereby exhausted; if not, a fracture of the base may arise from the head being driven down upon the summit of the spinal column. If

the weight striking the vertex is of a yielding material, then fracture at this part will not ensue, but fracture of the base alone from impact with the spinal column; or if the yielding force strikes the sides of the head, it may drive it against some obstacle outside the body, producing fracture at that part. The same is seen when a person falls from a height on the head: the entire weight of the trunk, with the superadded momentum, is concentrated round the condyles of the occipital bone, and the central fossa of the base of the skull is broken across. The force of a blow on the upper part of the frontal is communicated to the parietal bones. Force applied to the anterior aspect of the frontal may produce either direct fracture or fracture of the anterior compartment of the base. Blows on the occiput are very prone to fracture that bone; and this may also lead to longitudinal fracture of the posterior and middle fossæ. Injuries to the temporal region are followed by fractures of the middle fossa and petrous bone.

Fractures of the skull may be divided into those of the *vault* and those of the *base*; while under the former, the fissured, punctured, and depressed fractures are usually considered.

FRACTURES OF THE VAULT.—Fractures of the vault are generally caused by direct violence. They include most of the punctured fractures and incised wounds of the bone. They are commonly compound, and the brain-injury associated with them is, as a rule, local. They are frequently comminuted. Fissured fractures of the vault are generally associated with basal fractures, the one running into the other. Compound fractures are usually confined to the spot to which the force is applied, while simple fractures are most apt to spread.

Fissured Fracture.—As seen in the cadaver, a fissured fracture is easily discovered by its red outline, contrasting with the general white surface of the skull when denuded of periosteum. The fissure is red from the blood existing between the lips of the fractured bone. In this way fissured fractures contrast with the sutures of the skull, while the latter are further distinguishable by the irregularity of their interdigitating processes. This is best seen in children and young adults before synostosis sets in. It must be remembered that a fissure may actually pass through a portion of a suture, which would then present a red appearance from extravasated blood. As met with in practice, when uncomplicated by a scalp-wound, a fissured fracture cannot be discerned. The probability of its pre-

sence may be indicated by certain symptoms arising from the outpouring of blood into or from the cranial cavity. When there is a wound of the scalp exposing the fracture, it may be discovered by the eye, or felt by the finger-nail, or by means of a probe. When the wound is examined shortly after the accident, blood may be seen to ooze from the fracture, and to reappear as often as the wound is sponged out.

There are two sources of fallacy. The sutures may be mistaken for a fissured fracture. Their anatomical position, the irregularity of their outline, coupled with the fact that there is an absence of oozing of blood from between their edges, is sufficient to enable a distinction to be drawn. The other mistake is one which the writer knows has been frequently made, and is all the more liable to occur inasmuch as it has not been pointed out. It arises in scalp-wounds which have penetrated the periosteum, dividing it cleanly, but leaving one side of the periosteum closely adherent to the skull, while the other is raised so as to expose the bone. If the probe be used in such a case, it glides over the surface of the exposed bone until it meets with the sharply-cut edge of the periosteum, which is so thin, tense, and firmly adherent to the bone as to convey the impression that the probe has caught in a fissured fracture. This error may be avoided by digital examination, when the periosteum may be detected by raising a small portion on the finger-nail, as also by the sensation from the membrane itself. It must be remembered that when a scalp-wound does not also penetrate the periosteum, the fissured fracture will be difficult to make out, more especially as there is frequently a quantity of blood effused from the fissure between the periosteum and the fracture.

Punctured Fracture of the Skull.—When the skull has been punctured, the blow which inflicted the injury must have been delivered with considerable momentum, and by a linear or sharp-edged body. Under this heading there are many cases included which might with more propriety be described as wounds or cuts of the skull, inasmuch as the instrument or material with which it has come in contact has actually cut its way into the bone, and has not fissured or fractured it. Such punctures are frequently the result of violent blows with glass or earthenware; and when this is the case, a portion of these substances is often found embedded in the skull, and broken off so flush with its external table that it presents merely a rough-

ened edge, barely distinguishable by the probe, though more easily discerned by the finger. Knives seldom produce punctured fractures, and it is comparatively rare to find portions of them embedded in wounds of the skull, although this has been seen. When the fracture is linear, and there is nothing driven in between its edges, it may not be easily made out in the first instance. A scalp wound, in communication with a punctured fracture, does not always expose the fracture to view, the opening in such cases being more or less valvular. This arises from the mobility of the scalp over the skull. A lad who suffered from two punctured fractures of the skull, communicating with two valved wounds, was examined by a surgeon of considerable experience, who did not detect their presence until, at a second examination, he used his finger instead of the probe, when they were made out, and a small portion of bone removed from one of them. Punctured fractures are almost always compound, though the writer has seen one case in which there was a simple punctured fracture, the scalp being intact, but driven into the narrow osseous gap. In primitive forms of warfare, punctured fractures of the skull, arising from blows from arrow-heads, daggers, and from thrusts by spears, were much more common than they are at present.

Depressed Fractures of the Skull.—These fractures are generally easily recognised by the fact that, at a given spot, the normal contour of the skull is broken by an evident pitting or depression. When compound, this depression becomes very obvious and is often visible. As a rule, the periosteum has been torn and the bone exposed, but it occasionally happens that the periosteum remains intact, when the effusion of blood, issuing from between the fractured edges, strips and raises it from the skull until the depression is obliterated. Not only so, but, owing to the great tenseness of the over-stretched periosteum, a firm feeling is imparted to the finger, the nature of which, if not carefully examined into, might be misleading. This tension disappears in a few days with the shrinking of the blood-clot, when a more accurate diagnosis may be made. The depression may involve one or both tables of bone. When fracture of the outer table alone occurs, the depression is extremely slight, as the outer table can only be depressed to the extent of the depth of the diploë, except in the frontal region, where the outer table may penetrate the frontal sinuses. The inner layer of bone is occasionally fractured

alone, and this generally happens when the agent acts on the outside of the cranium, and the force is at the same time not severe.

When the force with which it acts is greater, and it impinges on the outside, both tables are generally broken, but the inner one is more depressed and more comminuted than the other. It is also found that, when the force acts from without, the inner table gives way first, and is fractured to a greater extent than the outer. When the force acts from within the cranium, the reverse is the case, the external giving way first, and being more severely fractured than the internal table. This occurs when bullets, after entering the skull at one place, strike the inner table at another point in their outward course. There are various reasons why the inner table gives way to a greater extent than the outer, on the application of external force. In the first place, the inner table is both thinner and more brittle than the outer. Secondly, the force as it travels through the diploë becomes distributed, and strikes the inner table over a wider area; and thirdly, the inner table forms a smaller curve than the outer one.

In children, depression of the bones of the skull is said to take place occasionally without fracture. There is generally an over-stretching of the osseous fibres, which is probably always associated with greater or less rupture, or *green-stick* fracture. It is true that the bones of infants are sufficiently elastic to bend without rupture of the fibres, but such indentations in the skull will not remain after the withdrawal of the bending force, the elasticity of the bone restoring the form. M. Péan has had several autopsies on the bodies of newly-born infants affected with this form of injury, and found that these *enfancements* were always co-existent with fracture of the internal table, and sometimes of the outer one also. As to the *prognosis* of depressed fractures or indentations in the bones of infants, either of two results may follow. If the bone so bent be sufficiently elastic, it will, within a comparatively short period, assume its former contour. If, on the other hand, there has been a considerable rupture of the osseous fibres, especially of the inner table, and plastic infiltration quickly occurs, the deformity is apt to become fixed, and may remain permanently so, unless relieved by operation.

In relation to simple depressed fracture of the skull, it is well to bear in mind that an appearance closely resembling this condition is brought about in some contusions

of the soft parts. Where this occurs, there is a somewhat circular elevation of the scalp with a soft and sometimes depressed centre, which simulates a depression in the bone. This appearance is generally attributed to the effusion of blood, which coagulates round the circumference, while it remains fluid in the centre. The writer has had numerous opportunities of seeing this condition, both in the cadaver and on the living subject, and explains it as follows:—The central portion is the point which has been subjected to violent compression between the impinging body and the skull. In this part the cellular tissue has been broken up and scattered centrifugally, its elements, together with the neighbouring cellular tissue, causing a heaping up and condensation of the cellular tissue at the circumference, which soon becomes more dense by the infiltration of blood. The central portion of tissue on rare occasions remains adherent to the tendon, but it is usually separated from it by a quantity of fluid blood. There being no tissue intervening between the skin and the tendon, or, if any, it being in a highly rarefied condition, the centre has a peculiar soft yielding feeling, as if there was a complete hiatus in the osseous wall. This condition is differentiated from fracture with depression by the fact that the application of *firm* steady pressure, exercised by the finger, dispels the raised margin. The word ‘firm’ is italicised, as in some cases it requires considerable steady pressure to dislodge a portion of the margin.

FRACTURES OF THE BASE.—Fractures of the base may arise from direct violence, as when a sharp body has been forced through the orbital or nasal roof, or through the pharynx into the middle fossa. The posterior fossa may be fractured by violence applied to the nape of the neck. Basal fractures are, however, most generally produced by indirect violence. A blow upon the nose, by driving in the ethmoid, may cause fracture of the anterior fossa. The cribriform plate of the ethmoid and the orbital plate of the frontal have been fractured by blows on the anterior aspect of the frontal. The writer has seen a case of fracture of the orbital plate of the frontal, which had been caused by a blow with the fist on the brow. This history was well authenticated, and there was no other injury of the patient’s person which might have suggested a different conclusion. Falls upon the chin have been known to result in the driving of the condyles of the lower jaw through the glenoid fossæ into the interior of the skull. Fractures in the

occipital region have arisen from falls on the feet, knees, or buttocks, the force being transmitted through the vertebral column to the occipital condyles. Many basal fractures occur through the person falling while walking, the head coming into violent contact with the pavement. It used to be believed that many fractures of the base were due to *contrecoup*; this belief is now generally abandoned, though there are a few cases which may be explained in this way, such as a fall on the back of the head occasioning a fracture on the right side of the occiput and, at the same time, a fracture of the orbital plate of the frontal, on the left side. There is little doubt that the majority of linear fractures of the base are associated and continuous with fractures of the vault. It is well to bear in mind that fractures of the base may arise from what are considered to be comparatively trifling accidents, such as falls on the pavement.

In all cases, the head ought to be carefully examined for marks of violence. In the case of dark, dense-haired persons, bruises of the hairy scalp are easily overlooked, unless sought for in a good light. Where there is difficulty, and the case is a serious one, shaving of the head reveals the livid patch. In light-haired persons, no difficulty of this kind is experienced.

Fracture of the Anterior Fossa.—A fracture produced by a blow on the anterior portion of the frontal bone will probably be situated in the anterior fossa, though, if more severe, it may spread beyond it into the middle fossa. Blood sometimes escapes from the nose in fractures of the anterior fossa. This blood is derived from the meningeal vessels or torn mucous membrane of the roof of the nose. In one instance it came from the anterior portion of the superior longitudinal sinus, which had been torn; the *crista galli* having been driven upwards and backwards, while the cribriform plate of the ethmoid was crushed. If cerebro-spinal fluid escapes from the nose in a case of fracture of the base, it will show not only the mucous membrane on the roof of the nose, but also the brain-membranes, to have been ruptured.

In fractures of the anterior fossa, the blood may not escape externally, but may infiltrate the tissues surrounding the eyeball and also the conjunctiva of the eyelids. This appearance may be simulated by extra-cranial infiltrations. First, there is the common bruise of the eyelids, known popularly as a 'black eye,' and, secondly, there is the very common infiltration of the eyelids which follows wounds or bruises of the

brow. To attempt to differentiate between fractures of the skull and these two affections by the colour of the eyelids is altogether erroneous. The other signs generally advanced as diagnostic require to be carefully considered in relation to the supposed injury. The appearances differ in fracture according to its precise locality, and particularly whether the orbital plate of the frontal bone is implicated; or whether the fracture involves the orbital ridge of that bone. In the former, the reflection of the fibrous tissue from the periosteum to the tarsal cartilages is maintained intact, preventing the effusion of blood into the eyelids before, at least, it has passed into the conjunctiva; while in the latter it is ruptured, thereby permitting the blood to infiltrate the eyelids directly.

When fracture is confined to the orbital plate, there is observable, soon after the accident, a prominence of the affected eyeball. This is followed by the infiltration of blood into the conjunctiva, which takes place from behind, gradually implicating the anterior parts. Then the lower eyelid becomes puffy, much the same at first as in oedema, but deeply situated in the tissue a discoloration is discernible, which becomes more and more apparent until the colour is a pronounced shade, varying from a dark red to purple. The upper eyelid may escape the infiltration, or it may become involved at a later period, but it is seldom so distended or discoloured as the lower eyelid. In bruises of the eyelids—the ordinary 'black eye'—the eyelids swell with great rapidity, and are often so distended, shortly (two hours) after the injury, that they can with difficulty be opened. When forcibly opened, the conjunctiva is found to be frequently, though by no means always, free from infiltration. When it is devoid of discoloration at the beginning, it generally remains so throughout. In bruises situated on the brow above the orbit, the eyelids swell first, the upper sooner than the under, and the conjunctiva is seldom involved. On the other hand, when the fracture extends through the orbital ridge, the discoloration and swelling take place rapidly into the eyelids as well as into the conjunctiva; so that such a fracture could not be distinguished by the appearances of the eyelids from either of the foregoing. It is comparatively seldom that the strong orbital ridges give way. A surer sign of the fracture in this region is paralysis of some of the muscles of the eyeball, indicating injury to the orbital nerves.

In fractures of the anterior fossa, even when accompanied by severe injury to one

of the frontal lobes, there is frequently, at first, either very slight indications of brain-complication, or there may be absolutely none. In such cases, forty-eight to seventy-two hours have elapsed before serious symptoms have arisen, indicative of contusion or laceration in this region.

Fractures through the Middle Fossa.—Blows on the vertex and temporal regions and falls on the occiput are prone to produce fractures of the middle fossa.

The diagnosis of this injury is based on three points: a discharge of blood, an escape of cerebro-spinal fluid, and a facial paralysis. A flow of blood from a healthy ear may possibly arise from a rupture of the membrane of the tympanum, and in that case the bleeding would be derived from the vessels of the membrane of the tympanum. The blood which flows from an injury of this kind is generally bright in colour and very small in amount, and, owing to the contraction and retraction of the vessels, it ceases spontaneously. On the other hand, the blood which issues from the external auditory meatus in a case of fracture of the petrous portion of the temporal is generally dark-coloured, wells slowly and continuously for hours and sometimes for days or longer, during which its colour gradually becomes lighter, from the admixture of cerebro-spinal fluid with the stream. This blood comes from some of the larger vessels inside the cranium, and not infrequently from the lateral sinus. Subsequently, the discharge from the ear consists entirely of clear fluid, which often continues for days to stain the pillows. Before this cerebro-spinal fluid could come away, the tubular prolongation of the brain-membranes surrounding the seventh pair of nerves must have been torn, and the fracture must have passed through the internal auditory meatus. There must likewise have been a rupture of the membrane of the tympanum, and a communication between the internal ear and the tympanum.

Where there are wounds on the face, head, or neck, blood in considerable quantity may be found in one or other ear, and it then becomes necessary to determine whether it comes from the wounds or from the interior of the skull. The blood as it passes from the wounds to the ear may leave a track, which would be of value if it were not for the fact that blood, issuing from the interior of the skull and flowing from the ear, may leave a track of the same kind, the blood from the ear mingling with that of the wound. In any case of doubt, the ear ought to be wiped out with a piece of

lint in a pair of dressing-forceps. The wounds on the scalp or face should then be dressed, and the ear carefully watched for reaccumulation of blood. If this does take place, the fact that it comes from the interior of the ear will be established. There are instances in which the fracture of the petrous portion has occurred, accompanied by the rupture of the other parts as already described, with the exception that the membrane of the tympanum has not been torn. The flow of blood takes place from within, but, as it cannot escape from the external ear, it follows the course of the Eustachian tube and thereafter escapes from the mouth and nose. The blood may also be swallowed, and hæmatemesis may follow subsequently. Occasionally, even when the tympanic membrane has been ruptured, the blood finds its way through the Eustachian tube, as well as through the external ear; there is then bleeding from the mouth, nose, and one ear. In some cases of fractured base, infiltration is observed at the posterior aspects of the pharynx, and when the mucous membrane of the pharynx has been ruptured, persistent bleeding is apt to occur. From such a fracture, with rupture of the mucous membrane of the pharynx, there may also be a discharge of cerebro-spinal fluid. Whenever there is clear evidence of the escape of cerebro-spinal fluid, the diagnosis of fracture of the skull may be regarded as almost certain. If, in addition to the flow of blood at the beginning of the case, and the escape of cerebro-spinal fluid, there is loss of sensation and motion of the parts supplied by the fifth and seventh nerves, the diagnosis becomes complete.

The cerebral symptoms accompanying fractures of the base are very varied. At first there may be nothing wrong mentally, and in such cases it may be difficult to persuade the patient or his friends that he has sustained a serious injury. More often, there is confusion of thought and unsteadiness of gait. If the fracture be accompanied by considerable brain-pressure, there will be insensibility. In most cases there is insensibility, as an early if not an immediate feature in fracture of the base, though the insensibility be not necessarily indicative of pressure. Given an insensible person who has met with an injury, and who has bleeding from the ear, the presumption is that he suffers from fracture of the middle fossa of the base. The great majority of fractures of the base are of the middle fossa.

Fracture of the Posterior Region of the Skull.—There are few cases in

which there is fracture of the posterior, without also the middle fossa being implicated. When they do occur separately, their differential diagnosis is very difficult, except when there are local signs to guide one. Blood, extravasated over or in the neighbourhood of the mastoid and occipital regions and at the sides of the neck, is frequently seen some days after the posterior fossa has been fractured. Occasionally, there is also tenderness on pressure on the mastoid process. These signs are of special value, when the seat of external violence is at a distance from the parts into which the infiltration occurs. If the functions of the eighth and ninth nerves were specially involved, as evidenced by impairment in swallowing and in the movements of the tongue, a guide to the lesions in this region would be established. These indications are, however, generally lost in the insensibility which is apt to be present in traumatic cases affecting this region.

TREATMENT OF FRACTURE OF THE SKULL.

As the gravity of fracture of the skull depends on the degree and the extent of the cerebral involvement, the treatment will naturally be directed, first, towards the prevention of cerebral complications; and, second, to their relief when they arise. As the latter are fully treated of under the headings of CONCUSSION, COMPRESSION, and ENCEPHALITIS, the former only are dealt with in this article.

The fractures which are most apt to be complicated by cerebral affections are the compound, the punctured, and the depressed. All compound fractures must be rendered aseptic and maintained so throughout. This is the surest way of preventing meningitis and encephalitis, as a septic state of the wound is the most frequent cause of these affections. To render the part aseptic, the hair should be shaven and the scalp thoroughly purified, first by soap and water, then by turpentine, for the removal of greasy matters, and finally by the application of an antiseptic solution. Drainage ought to be attended to, and an antiseptic dressing applied, which should be fixed in position by elastic webbing. Iodoform dusted round the circumference of the wound is a valuable aid in keeping the wound-secretion aseptic. A dressing of antiseptic gauze or sublimated wood-wool ought to be applied. In fracture of the middle fossa, with rupture of the membrane of the tympanum and the escape of blood and cerebro-spinal fluid, the same precautions ought to be adopted. An antiseptic powder, such as iodoform, may be put into the external ear, provided it does not

so completely occlude the orifice as to prevent the escape of discharge. All operations on the skull and its contents must likewise be conducted under rigid antiseptic precautions.

Regarding depressed fractures, all surgeons agree that the depressed bones ought to be elevated, when they produce symptoms of compression. But the same unanimity does not prevail concerning the treatment of depressed fractures, when unaccompanied by cerebral symptoms; most advising that they be left alone, while a few recommend their elevation. A considerable depression of bone is required to produce immediate and pronounced symptoms of compression, and there can be no doubt that a large number of cases of depressed fracture recover without elevation of the fragments. But there is reason to believe that, in not a few instances, although immediate recovery has taken place and the patient has been discharged from the hospital as cured, yet in the course of months certain cerebral changes become developed, as evinced by motor, sensory, or psychic phenomena; and in some, these affections become permanent or ultimately lead to a fatal issue. It may be alleged that such cases may have had brain-lesions independent of the depression of the bone; but of this there was no evidence, while the fact of the depression of the skull was clearly established. Besides, one never knows by the external appearances to what extent the inner table of the skull has been depressed, although it is safe to state that it is depressed to a greater extent than the outer table.

The chief reason against the elevation of the depressed bone lies in the fear of exciting inflammatory action in the membranes or in the brain itself. There was good ground for this fear so long as wounds were not kept aseptic; but with the means at present at the disposal of the surgeon it is no longer tenable, and what remains for the surgeon to make sure of is, that the depressed bone or spicula which may be driven through the membranes do not maintain compression or incite irritation, which may lead to inflammatory action of an acute or chronic character. Therefore, when there is marked depression of the skull involving both tables, it ought to be elevated, without waiting for the development of symptoms of compression or of irritation, provided the surgeon has the means of preserving the wound in an aseptic condition. Punctured fractures ought to be treated in the same way, as far as the

antiseptic precautions are concerned. They ought to be carefully explored and all loose fragments elevated.

The depressed portions of bone may be raised by means of an elevator placed under the extremity of one of the fragments. The instrument rests on the border of the sound skull as a fulcrum, while the elevator is used as a lever to lift the fragments outwards. There are many cases, however, in which the elevator cannot be used in this way at first, owing to the fact that there is no gap in the depressed bone into which the elevator may be passed. In such cases, an aperture requires to be made at the side of the depressed bone by means of a saw or a trephine. In using the latter, the central pin of the instrument ought to be placed on the sound skull and made to penetrate its substance sufficiently to steady the trephine, thus preventing slipping, and permitting the rotatory action of the circular saw to be maintained until it has made a sufficient sulcus for itself to enable it to run without the central pin, which should then be withdrawn. As the inner table is reached, great caution must be observed to prevent penetration of the membranes. This risk may be lessened by frequently inserting a probe into the grooves and removing the bone-débris produced by the saw, at the same time exploring the depth to which it has penetrated. When the sawing is completed, the elevator may then be brought into use and the disc removed. The aperture thus made will permit of the depressed bones being elevated.

After having elevated the portions of bone from a depressed fracture, instead of leaving the brain and its coverings exposed, the bones so removed should be carefully preserved under aseptic conditions until the completion of the operation, when they may be replaced in part at least, so as to form an osseous wall over the aperture. The writer has frequently adopted this practice with complete success.

In all fractures of the skull, the patient ought to be placed in bed in a quiet room, the head shaved, a brisk purge administered, and a low diet given. He ought to remain in bed for at least four weeks, and be kept under observation for months afterwards.

CONTUSION OF BONES OF SKULL.—Blows on the head may produce contusion of the skull, with or without the production of wounds, and they are sometimes followed by inflammatory action in the bone, which may induce hypertrophy, or may lead to caries or necrosis. In some instances, the periosteum and the dura mater may be

separated from the bone at the injured part, when necrosis of both tables may ensue. In others, the periosteum may alone be separated, and the external table may be driven into the diploë, resulting in a separation of the external table. In one instance, at least, a considerable portion of the internal table of the calvaria was found separated from contusion. In such cases, inflammatory action may take place in the diploë, and from thence the inner table is apt to be affected. There is danger of the inflammatory action spreading from the bone to the brain-membranes, or even inducing pyæmia through the infection of the veins of the diploë.

When the inflammation spreads to the membranes, the dura mater becomes separated from the bone by a layer of plastic effusion, or of pus. The bone, if denuded, becomes dry, and by-and-by discoloured. If the scalp remain intact over the contused bone, an œdematous condition of the soft tissues frequently takes place coincidently with the purulent effusion into the diploë, or under the skull. Accompanying this condition there is persistent headache, frequently localised pain, corresponding to the seat of inflammatory action, and an increased temperature. In a few cases these symptoms set in early, but in the majority they occur from two to three weeks after the accident. When the inflammation spreads beyond the dura mater, involving the arachnoid, it no longer remains localised, but becomes diffused over the surface of the membranes; and if the inflammatory action be intense, the visceral layer, the pia mater, and the surface of the brain become implicated. Rigors, at this stage, are frequent, with occasional vomiting, drowsiness, coma, and paralysis.

These symptoms are prone to arise in contusions of the bone, complicated with wounds which are permitted to become septic; seldom do they set in under thoroughly aseptic conditions. When such symptoms do arise, the first thing to be attended to is the condition of the bone; and if it be dry or necrosed, it ought to be removed, thus giving exit to any inflammatory products which may exist between the dura mater and the skull. If the pus be under the dura mater, and especially if an abscess has formed, this membrane will not evince the cerebral pulsations and will probably bulge into the trephine-opening. If this is the case, the membrane should be opened, and the pus permitted to escape. See further under **ENCEPHALITIS AND MENINGITIS.**

WM. MACEWEN.

SLOUGH and SLOUGHING.—When gangrene occurs in the soft tissues, the dead portion is called a *sphacelus* or *slough*; whilst the gangrenous process by which the slough is produced, and the ulcerative process by which it is separated, are often spoken of as *sloughing*. Sloughing, therefore, is not a pathological process distinct from gangrene and ulceration, but a term conventionally applied to certain forms of these morbid processes. Thus when, after an amputation, from deficient blood-supply or other causes, portions of the flaps die and are cast off in the form of shreds or semi-solid masses, they are said to be sloughing. When a wound or ulcer takes on an acute inflammatory action, and rapidly enlarges by the death, in visible masses, of its edge or granulations, it is called a sloughing ulcer; whilst again, when under certain circumstances a portion of tissue—a tendon, for example, in the case of a whitlow—becomes gangrenous, the process of ulceration by which it is separated is spoken of as sloughing. But not every process of gangrene is so termed. Thus, when the whole foot dies in old persons, or gangrene rapidly spreads up a limb, the foot or limb is not said to slough, but to mortify, or to be in a state of gangrene; neither is the separation of such gangrenous masses, as a rule, designated sloughing. *See also HOSPITAL GANGRENE; Sloughing Ulcer under ULCERS.*

W. J. WALSHAM.

SLOUGHING PHAGEDÆNA. *See HOSPITAL GANGRENE.*

SMITH'S (NATHAN) ANTERIOR SPLINT for the lower limb is best made of two stout wires fixed together by transverse bars; the splint should reach from the lower part of the abdomen to the toes, and should be bent slightly opposite each of the three joints of the limb; the splint should be suspended over the limb, and the latter bandaged to it from the foot to the groin. It is a useful splint for treating wounds and compound fractures involving the posterior part of the limb.

SNUFFLES. *See CONGENITAL SYPHILIS.*

SPECTACLES. *See ACCOMMODATION, Disorders of; CATARACT-GLASSES; REFRACTION, Errors of.*

SPECULA are instruments employed to conduct the rays of light into some of the internal passages of the body, and also to separate the walls of those cavities so

that their entire surfaces may be successively brought under observation, either for the purposes of diagnosis or operation.

Bright daylight, when obtainable, affords sufficient illumination for most purposes; for the examination of the nasal cavities the light reflected from a white cloud serves admirably, if focussed on the diseased parts with a mirror. If the light be bad, or if it be difficult to obtain owing to the position of the patient, artificial illumination must be employed. For the examination of the middle ear, a strong artificial light should be reflected into the meatus with a mirror.

The specula here described are grouped according to the regions for which they are most employed.

VAGINAL SPECULA may be classed under four heads, according to their mode of action—viz. the tubular, the duckbill, the bivalve, and the three- or four-bladed dilating specula.

Tubular Specula.—The best known speculum of this shape is Fergusson's. It is made of silvered glass, coated externally with gum elastic. The diameter of the tube is the same throughout. The distal or uterine end is bevelled, so that one side—the anterior—is shorter than the other. The proximal end is trumpet-shaped. The great objection to Fergusson's speculum is its liability to break, but this may be obviated by substituting metal for the glass. Hall Davis's speculum differs from Fergusson's in being made of metal or celluloid, and in tapering slightly towards the uterine extremity. It is claimed for this instrument that it is easier to introduce, that it possesses more illuminating power, and is not so fragile as Fergusson's speculum. Tubular specula act by distending the vagina longitudinally, and pushing the uterus before it; they afford good illumination, but unless as large a size as possible be employed, the folds of a lax vagina often obstruct the view.

Duckbill Specula.—Sims's speculum is made of plated metal, and consists of two specula or blades of different sizes, united together by a handle, which may be either rigid, or hinged in the middle so as to allow of its being folded up to half the size. Each blade is hollowed on its anterior surface, and its end is turned upwards so as to resemble a duck's bill; the blades of the real Sims's speculum are set at right angles with the handle, but in some modifications of it (Bozeman, Battey), the blades are set at an acute angle with the handle. This speculum is employed with the patient in

the semiprone or in the lithotomy position, and its blade is meant to lie on the posterior wall of the vagina with its extremity behind the cervix of the uterus. If the anterior wall of the vagina is lax, it falls down and obstructs the view; to obviate this a loop of wire may be so hinged to the base of the speculum (Griffith's), that by depressing the external end of it the uterine one may be raised so as to support the vaginal wall.

The modification of Sims's speculum, known as Neugebauer's, is divided transversely in the handle but capable of being joined together again; the ends of each blade are, however, open and in a line with the general curve of the instrument, instead of being turned up or inverted like the duck-bill. The lesser blade can be fitted into the larger in such a way that a bivalve or tubular speculum is produced. The posterior blade should be introduced first, so that its extremity lies behind the cervix, and then the anterior one should be introduced with its borders turned to those of the other blade, and in such a way that they fit within them. When in position, the blades work on one another like a bivalve speculum, and, consequently, by approximating the handles the opposite ends of the specula become separated, and the deep part of the vagina dilated. Barnes's crescent speculum is a modification of the last-mentioned, in which each blade is crescent-shaped, and each extremity of the blades is like the uterine end of Neugebauer's instrument.

Bivalve Specula are composed of two blades hinged together so that they may be separated either in an antero-posterior or lateral direction. Bennett's, Barnes's, and Cusco's specula are instances of the first kind, and Ricord's of the second. Both Barnes's and Bennett's specula are tubular when closed, but as their uterine ends are not bevelled, a plug with a rounded end is used to facilitate their introduction; by means of a screw one of their blades can be raised or depressed. Cusco's instrument does away with the necessity for the plug, for it is composed of wide and almost flat blades which, when they are shut, fit accurately together, both along their borders and at their extremities. The blades may be plain or fenestrated. By means of the screw, which acts on both blades, the instrument may be opened. Cusco's speculum should be introduced with its blades looking laterally, but before it is pushed completely in, the instrument should be rotated so that they look antero-posteriorly. The blades of Ricord's speculum are hinged to-

gether at a little distance from their external extremities, and, by approximating the handles, the uterine ends of the blades may be separated laterally. Reeves's dilating speculum is a bivalve instrument, the blades of which open laterally; by means of screws and levers it is possible to separate the blades either at one or other of their extremities or along their entire length. Nott's speculum is a three-bladed instrument, but its principle of action is similar to Cusco's bivalve; instead of the single upper blade of the latter, Nott's speculum has two narrow blades.

Dilating Specula are three- or four-bladed instruments which distend the vagina both antero-posteriorly and laterally. Meadows's three-bladed instrument consists of a lower blade, which has a duck-bill shape, and of two narrow upper blades, which are bent at a right angle a little in front of the hinge by which they are attached to the lower blade; when the upper blades are separated from one another, they are also raised equally along their entire length. Meadows's four-bladed dilating speculum has an anterior and a posterior duckbill-shaped blade, and two narrow lateral blades; the latter are forced outwards when the former are opened by means of a Cusco's screw. Scanzoni's speculum consists of four stout metal rods with inverted extremities: when the blades are shut the instrument becomes a fenestrated tubular speculum, which is easy to introduce; by means of handles and screws all four blades can be separated.

RECTAL SPECULA.—Many of the vaginal specula are equally servicable for examining the rectum.

Fergusson's rectal speculum is made of silvered glass coated with gum elastic; it is a tubular instrument with a rounded end and a narrow opening on one side. Gowland's specula are made of plated metal, and further differ from Fergusson's in having a much wider opening along one side, in being open at the distal extremity, and in tapering slightly from the outer to the inner end. They are introduced with a plug. Hilton's speculum is made of metal, and resembles Fergusson's except that it tapers a little towards the distal end; it is provided with a plug and with a metal handle, which is fixed by a hinge to the proximal extremity. Bryant's speculum consists of two duckbill blades, each of which is attached to a separate handle; one blade fits into the other so as together to produce a tubular speculum with a closed end; after introduction the blades can be separated

after the fashion of a bivalve speculum. The two handles can be fixed together so as to produce a speculum very much like Sims's duckbill. Allingham's speculum is a four-bladed instrument, which, when the blades are closed, occupies very little room and is consequently easy to introduce; when the blades are opened, the whole circumference of the rectum can be seen at one view. Lane's speculum is a three-bladed instrument; the blades are much broader than those of Allingham's speculum. Hogan's speculum is composed of two metal rods, each of which is bent at an angle in the middle; one of the ends of each rod is fixed to the extremity of one of two levers, which can be separated by handles; the other end can be fixed into notches along the side of the levers. When the levers are approximated and the blades released from the notches above mentioned, the speculum becomes very small and can be easily introduced. By separating the levers the rectum becomes distended laterally, and by depressing the free ends of the bent bars and fixing them in one of the notches on the sides of the levers, the rectum becomes distended antero-posteriorly also. *See* ENDOSCOPE.

URETHRAL SPECULUM.—Bryant has introduced a small speculum and dilator made of box-wood or ivory, which he finds of great use when removing vascular growths from the female urethra. The speculum is a hollow conical instrument with a broad cleft along one side.

NASAL SPECULA.—For examination of the anterior portion of the nasal cavities Fränkel's speculum is one of the best; it consists of two skeleton blades hinged to a transverse bar, through which a screw works so as to act by means of levers on both blades. The blades of the instrument should be introduced closed into one nostril, and then separated sufficiently to afford a good view and to be self-retaining. The handle of the instrument hangs down over the lip, and is quite out of the way. The skeleton blades may be replaced by solid ones (Von Tröltsch), and the screw arrangement for separating the blades may be replaced by a loop of wire, which has sufficient elasticity to keep the blades apart (Goodwillie). Sliding ivory plates may be adapted to the fenestrated blades, so as to protect the nostril during the applications of the cautery. Thudichum's speculum consists of two flat blades of metal or bone united by a loop of wire, the elasticity of which keeps the blades well apart. Lennox Browne's speculum is an ivory cylinder

with a blunt end and an open upper surface; it is introduced by means of a plug.

Elsberg's speculum is composed of three blades, which are set at an angle of 90° or a little more with the handles. The two lateral blades are separated by approximating the handles, either quickly by the hand or more slowly by means of a screw. As this is done, the lower blade is depressed by means of two levers united to a rod connected with it and the handles of the instrument. Duplay's speculum is a very useful instrument for displaying the deeper parts of the nasal cavities; when closed, it has the shape of a hollow cone with flattened sides and a rounded apex; it is a bivalve instrument, and its blades can be separated by turning a screw. The inner blade is more flattened than the outer, and it is continued into the trumpet-shaped proximal end of the instrument. The outer blade is the one which is moved by turning the screw. Schuster's and Votolini's specula only differ from the last in the means adopted to separate the blades. The bivalve specula afford a good view of the deeper parts of the nasal cavities, but if it be desired to examine the posterior wall of the pharynx and the region of the Eustachian tube through the anterior nares, Zaufal's funnel should be used. It consists of a long hollow cylinder of polished metal with a funnel-shaped outer extremity.

AURAL SPECULA.—The best speculum for most purposes is Keene's; it is a hollow cone of plated metal with a short cylindrical extremity. Toynbee's and Wilde's specula taper gradually from a trumpet-shaped outer end to a small elliptical or circular inner one. Specula, of similar shapes to the three already mentioned, are made of vulcanite and are very useful when substances which would tarnish silver are being used. Kramer's speculum is a bivalvular instrument, whose blades are set at right angles to long handles, by means of which its blades may be separated. It is rather inconvenient, because one hand is required to hold the instrument. Woakes' speculum is a useful bivalvular instrument; its principle of action is the same as that of Duplay's nasal speculum; it is self-retaining.

EYE SPECULA are employed to separate the eyelids. They are made of wire, and have two blades, which are so formed that they fit securely on to the borders of the lids. When the blades are separated, the eyelids are opened widely. The blades may be separated by a contrivance similar to that employed by Fränkel for his nasal speculum,

or by the elasticity of a spiral twist of the wire which unites the blades. If the latter method be employed, the instrument should be provided with a stop-screw, by means of which the separation of the blades may be checked when they have opened the lids sufficiently. The handle of the instrument should be curved, so that it may rest just above the zygoma, and be out of the surgeon's way.

BILTON POLLARD.

SPERMATIC CORD, Diseases of the.

In this article only abscess and the solid tumours of the cord will be considered. The fluid tumours and varix of the cord are described under HYDROCELE; HÆMATOCELE; VARICOCELE.

ABSCISS.—*Causes.*—Inflammation of the cord, running on to acute abscess, may be the result of injury, or complicate urethritis and epididymitis. In tubercular disease of the testicle, nodules of the same character are sometimes found in the cord, and they may soften down into chronic abscesses.

Symptoms and Diagnosis.—Acute inflammation of the cord causes a rapid, painful, and very tender swelling of the part, and, when abscess forms, the skin over it becomes œdematous and reddened, and fluctuation is detected. Tubercular disease of the cord usually causes a uniform enlargement of the vas deferens to the size of a quill or so, but it may lead to nodular swelling of the part, at first rounded and hard, and then softening down into a fluctuating swelling, which bursts and discharges thin, flaky, curdy pus. The diagnosis will be at once made by noticing tubercular disease of the testicle, and perhaps of other organs also.

TUMOURS.—The commonest of the solid tumours is lipoma; these growths spring from the scattered nodules of fat normally found in the cord, and which are continuous above with the subperitoneal fat. Myxoma and a mixture of mucous and fatty tissue—myxo-lipoma—also occur, especially late in life. Sarcomata may grow from the cellular tissue of the cord. Colloid and encephaloid cancer have been found springing from the vas deferens, and possibly also from the remains of the funicular process of peritoneum. These various forms of tumour have their usual pathological characters: the lipomata are often pedunculated; the sarcomata and carcinomata infect the lymphatic glands in the iliac fossa and other internal organs, and they and the myxomata may recur after removal.

Fatty tumours grow slowly, and, after attaining a certain size, may remain sta-

tionary for years. They are painless, smooth, soft, often lobulated in outline, and generally very movable. In some cases, when the patient stands up, a little swelling falls down through the external ring, and then, on the patient's lying down, it slips up again within the inguinal canal; this apparent reducibility of the tumour is unattended with gurgle, and, by careful manipulation, it is generally possible still to feel the tumour over the internal abdominal ring, especially if the finger be passed up into the inguinal canal. Where the tumour lies partly within the inguinal canal, it has a thrusting—not an expansile—impulse imparted to it by a cough. When the testicle is pulled down so as to put the cord upon the stretch, the mobility of the tumour is greatly lessened. From the position and apparent reducibility of these tumours they may be mistaken for hernia. From an enterocele they are to be distinguished by their greater mobility, dulness on percussion, constancy of size, absence of pain, absence of gurgle on reduction, and of expansile impulse on coughing; and by the fact that traction on the cord fixes the tumour and prevents its reduction. To epiplocele the resemblance is much closer, as both alike consist of masses of fat, and, like the tumour, the hernia may be irreducible. Lipoma is, however, free from pain or any sense of dragging, such as is met with in epiplocele; it is also more movable, often slipping about freely on its narrow pedicle; while its position, mobility, and apparent reducibility are affected by traction on the cord to a much greater extent than is an epiplocele. An epiplocele can always be traced quite up to the internal abdominal ring; many lipomata spring from the cord lower down, and when this can be distinctly demonstrated there can be no difficulty in the diagnosis.

Myxo-lipoma can only be distinguished from simple lipoma by careful microscopical examination, and by its tendency to recur after removal. Myxoma of the cord grows more rapidly and continuously than lipoma, is very soft, rounded in outline, and does not infect the iliac glands; the tumour may attain a considerable size. No differential diagnosis can be made between sarcoma and carcinoma of the cord: both alike are rare as primary affections. The tumours are firm, more fixed than lipoma, grow steadily, and generally rapidly, infect the iliac and lumbar glands, and become adherent to and fungate through the skin over them if left alone; in their later stages, the tumours

become uneven in outline and unequal in consistence.

Malignant disease of the testicle often spreads up the cord to the groin, and may form considerable masses in it, and after castration the disease may recur in the stump of the cord. Nothing is known of the causes of the primary solid tumours of the cord.

Treatment.—An acute inflammatory swelling of the cord is to be treated by rest and cold, or, if that fail to relieve quickly, by hot belladonna fomentations. Should an abscess form, an early incision is to be made into it; if considerable induration of the cord be left behind, it may be removed by a succession of small blisters. Tubercular disease of the cord requires the same treatment as the similar affection of the testicle. *See* TESTIS, Diseases of the. If a lipoma of the cord do not cause any trouble or inconvenience, and have ceased to grow, no treatment is required. Where, on the other hand, the tumour is still increasing in size, or from its size or position is a source of annoyance to the patient, it should be removed through a simple incision down to it, care being taken to enucleate the entire growth, but without inflicting injury upon the vessels or duct of the cord. To wear a truss for a small lipoma in the inguinal canal simulating a hernia is neither beneficial nor injurious. When, in operating for a hernia, one of these growths is detected, it should be removed. If, in a patient believed to have a lipoma of the cord, symptoms of intestinal strangulation come on, the surgeon should cut down upon the tumour and explore the part, as a small hernia might be concealed beneath it. A myxomatous tumour should be removed as early as possible, care being taken to keep outside the delicate capsule surrounding the growth. Malignant tumours of the cord should be excised if the iliac glands are not evidently infected, and as these growths infiltrate the cord and have a great tendency to recur, the entire cord, and the testicle, should be removed with the tumour. In the removal of benign tumours of the cord, castration is never justifiable.

A. PEARCE GOULD.

SPERMATORRHŒA.—The term spermatorrhœa is in every respect a bad one, and has been much abused. In its true etymological sense it means the discharge of the spermatic fluid or semen, without sexual desire or sexual excitement; and the malady from which the patient suffers has come to be regarded as the direct outcome of the loss of the seminal

secretion, when it is really due to the condition of the patient's mind, which, as Sir James Paget says, 'in reference to his sexual organs, is unsound.' The term has also been much abused, and often loosely applied by patients to the discharge of mucus, either prostatic, urethral, or vesical; to the gleet discharge due to a stricture or inflamed patch on the mucous membrane of the urethra, and even to the flocculent cloud of mucus which occurs in healthy urine, or the white deposit of phosphates when the urine is alkaline in some forms of dyspepsia.

Furthermore, the term has been applied to a frequent or even an occasional involuntary emission occurring during sleep, attended by erection and under the influence of lascivious dreams. These frequently occur, especially in early manhood, and often denote an excess of health and strength, and are simply the result of a hyper-secretion of the testes, occurring most frequently in young men of an excitable temperament.

By the term spermatorrhœa is meant a peculiar condition of hypochondriasis, engendered and maintained by an irritable condition of the sexual organs, which causes the frequent escape of seminal fluid, with or without the patient being aware of it. It is extremely doubtful, however, whether this latter condition, when the semen is passed without the knowledge of the patient, ever occurs; and such conditions as those spoken of by Lallemand, where seminal emissions occurred during micturition, and where there was a constant loss of semen with the urine, must be received with a considerable amount of doubt.

Such a condition as that described above, though happily a rare affection, undoubtedly does exist, and requires most careful consideration on the part of the surgeon, since it entails the greatest suffering, not only on the patient himself, but also often on those with whom he is associated by the closest ties.

Causes.—There can be no doubt that the most potent cause of spermatorrhœa is to be found in the habit of self-abuse, or in repeated venereal excitement in sexual intercourse. But other forms of local irritation, such as balanitis, phimosis, varicocele, rectal irritation from hæmorrhoids or fissure, intestinal irritation from the presence of worms, constipation or some derangement of the digestive organs, have all been accredited with causing this disease. Dicenta states that, in 500 cases of spermatorrhœa, he met with about 100

cases of some derangement of the digestive organs, generally constipation or dyspepsia, and about 50 of hæmorrhoids. Any of these conditions may excite the habit of masturbation, or, on the other hand, masturbation may cause most of them.

The exact manner in which the irritability of the sexual organs is induced, and what connection it has with the habit of self-abuse, is still the subject of considerable doubt. Trousseau believes that spermatorrhœa is due to some imperfection in the nervous system of organic life, since it is so commonly found in men who have suffered from incontinence of urine in early years; and regards masturbation as an indirect proof of a vitiated condition of the nervous system.

Dr. T. Clemens believes that hyperæsthesia of the urethral mucous membrane is a frequent cause of spermatorrhœa, and that the hyperæsthesia is due to some affection of the spinal cord, which has become 'exhausted' from misuse and excessive irritation of the genitals.

Lallemand, on the other hand, takes a very different view of the cause of spermatorrhœa, and believes that the disease is almost exclusively the result of irritation of the spermatic ducts arising from chronic inflammation, and that an old attack of urethritis is the most frequent cause of the seminal emissions.

Symptoms.—Almost always, if not always, spermatorrhœa begins with frequent nocturnal emissions, at first with, and afterwards without, erotic sensations. As the disease advances, these emissions become more frequent, occurring twice or thrice or even oftener in the same night, and unaccompanied by erection and even without any sensation being experienced by the patient. In consequence of this, partly as a result of the discharge, but also to a far greater extent from the mental disquietude which is produced, the patient becomes weak and irritable; he complains of heaviness and languor, disinclination to go about his ordinary occupations, and inability to fix his attention on any kind of work. As the malady progresses, emissions take place during the day, as well as at night, and from any slight cause, such as friction of the clothes in walking or riding; or, a mere reference to sexual matters or licentious talk may occasion an emission, without the usual amount of erection or sensation. If sexual intercourse is attempted, ejaculation takes place almost immediately, even before the introduction of the organ, and the act is therefore not

properly accomplished. This adds to the mental disquietude of the patient, who imagines that he has become impotent, and constantly broods over the subject, thus increasing his mental distress.

As a result of this uneasiness his digestion becomes impaired; he suffers from flatulency, heartburn, oppression in his breathing, and shortness of breath and constipation. He complains of aching pains, especially in the loins, and at last sinks into a condition of hypochondriasis, devoting the whole of his thoughts to his own unhappy condition, and taking no interest in the ordinary affairs of life. He is languid and depressed in manner and devoid of all energy. His eye is dull, his countenance pale and anxious, his expression listless. There is often impairment of vision, accompanied by extreme sensibility to light, and buzzing or singing noises in the ears. He may thus gradually drift into a condition of melancholia, and entertain the firm conviction that he is incurable and is fast sinking into an early grave; or he may even sometimes develop suicidal tendencies. The late Mr. Gascoyen has well summed up the symptoms of spermatorrhœa, when he says that they are a mixture of 'sexual irritability, mental uneasiness, dyspepsia, and hypochondriasis.' This exactly expresses the whole state of the case. As a result of sexual excesses or self-abuse, or it may be from some of the other causes enumerated above, an irritability of the sexual organs is set up, which induces emissions without adequate cause. Conscious of his immoral habits, the patient regards this condition as of serious import, and hence falls into a state of mental uneasiness, which speedily produces derangement of the digestive organs, and, as a natural sequence, all the horrors of an advanced hypochondriacal state. The symptoms, therefore, can scarcely be said to be due to the emissions, though in the first instance induced by them, but rather to some over-sensitive condition of the nervous system. It is not a disease of the sexual organs, but a disorder of the nervous centres. *See* HYPOCHONDRIASIS.

Diagnosis.—In the investigation of a case of spermatorrhœa, the first thing to do is to ascertain that the discharge is undoubtedly semen, and not the glairy fluid which sometimes exudes from the urethra, and which is either the natural secretion of its mucous membrane increased in quantity, or is derived from the prostate in cases of prostatorrhœa; and that it is not the discharge from a stricture or the remains of

an old-standing gleet. This point must be cleared up by the microscopical examination of the fluid, and the existence of true spermatorrhœa established by the presence of spermatozoa in it. Some care requires to be exercised in this, and it is well to examine the discharge on two or three occasions before coming to a definite opinion. The patient may recently have been attempting sexual intercourse or have been guilty of self-abuse, when spermatozoa would probably be found in the discharge, and this might lead to error. When the presence of spermatozoa has been definitely settled, the cause of the spermatorrhœa must be sought for. The condition of the external genitals must be examined; the presence or absence of balanitis, phimosis, or varicocele must be determined; the condition of the urethra must be investigated, and the existence of a stricture or tender spot on the mucous membrane ascertained, if it exists, by the passage of a bougie, of which the acorn-pointed one is the best suited for this exploration. The presence or absence of any rectal or intestinal irritation must be ascertained, and the general health of the patient, especially in regard to dyspepsia and constipation, inquired into. Finally, strict inquiries must be made as to the habits of the patient, whether he is still addicted to self-abuse, as unhappily is too often the case in the confirmed examples of spermatorrhœa.

Prognosis.—The issue of a case of spermatorrhœa depends, to a very great extent, upon whether the patient has entirely relinquished his evil habits or not. In many of these cases no persuasion, no fear, no threat will induce the patient to relinquish them. He appears to have entirely lost all power of self-control, and though he may promise and faithfully intend to keep his promise, he will relapse again and again. The outlook in such a case is gloomy. In some instances dementia is induced, in others active disease is set up as the result of the debilitated condition into which the patient has been reduced, and he falls a victim to his own folly. When, however, the evil habits are relinquished, the prognosis is hopeful, and the patient generally gets well under the influence of medical treatment and advice, and may be restored to perfect health and full vigour of mind and body, and become a useful member of society and a happy man.

Treatment.—The first point in conducting the treatment of a case of spermatorrhœa is to induce the patient to abstain,

at once and for ever, from his habits of masturbation, if he be still addicted to them. Without this, no other treatment can be of any avail. Every effort should therefore be made by the surgeon to induce him to relinquish them, by laying before him the consequences of his folly, if he persists in it, and assuring him, on the other hand, that if they be given up a perfect recovery may be confidently anticipated. In order to carry this out with greater effect, the surgeon should strive by every means in his power to obtain the confidence of his patient. In many cases, the sensible man will believe what he is told and will abstain from all further vicious habits, and his cure will already be half-effected. Others, on the other hand, do not appear to possess sufficient moral self-control to abstain, and, in such cases, it is advisable to keep the penis constantly sore with some blistering fluid. A ring of blistering fluid is to be painted round the penis, and as soon as this is healed or nearly healed, a second ring is painted on some other part. This is generally effectual in breaking the habit, at all events for a time, and patients will sometimes ask that it may be done, of their own accord, since they have not confidence in their own power of self-control. *See MASTURBATION.*

After this, the main treatment must be directed to the patient's general condition, to improving his health and keeping the mind and body engaged. This will have a far more beneficial effect than any medicine. All sedentary habits, with mental overstrain and excessive reading, must be abandoned, and the patient actively engaged in some outdoor occupation or pursuit. Something congenial to the patient's tastes should be found, so that, while his body is actively engaged, his mind may become engrossed in the pursuit in which he is engaged, instead of brooding over his troubles. A change of air, especially to some bracing seaside place, is desirable, where he may engage in fishing, rowing, boating, or athletics of some kind, so that each night may find him healthily tired. He should rise early, as soon as he wakes, and take a cold or tepid bath, or, what is better, a plunge in the sea. His companions should be cheerful and amusing, and it should be their endeavour to keep his mind occupied with their various pursuits and pleasures. His diet should be nourishing and unstimulating, and all highly seasoned meats and condiments should be avoided, and he should

eat no supper or heavy meal before retiring to rest. He should sleep on a hard, horsehair mattress, without too much clothing, and it is a good plan to advise his getting into the habit of causing his bowels to act the last thing before he goes to bed, so that a loaded rectum may not press upon his vesiculæ seminales. He should also be cautioned against sleeping on his back, and may be prevented from doing so by having some hard body, as a cork, strapped over the sacrum when he retires to bed.

Dyspeptic symptoms must be corrected by appropriate medicinal treatment, and the state of the bowels carefully attended to. If sleeplessness exist, it must be combated by the bromides of potassium or ammonium; but it is better to avoid the exhibition of these remedies, if it can be done, and to trust to active outdoor exercise inducing the weariness which will produce natural sleep. These measures, if steadily persevered in, will be found more efficacious than any special medicines, though these have been recommended by some. Trousseau strongly advocates the use of belladonna, and states that its utility depends upon its undoubted influence upon the entire nervous system, particularly on the encephalon and spinal marrow. Digitalis and aconite have been given with the same view, and to nitrate of silver, used internally, favourable results have been attributed.

Any special cause which can be discovered for the disease must, of course, be at once removed; such as an elongated prepuce, a phimosis, a varicocele, or hæmorrhoids or a fissure of the anus, and thus all source of irritation be got rid of.

Of local remedies, the one most extolled is the application of nitrate of silver to the prostatic portion of the urethra, either in the form of solid caustic, as recommended by Lallemand, or in solution, by means of the syringe catheter. The utility of this treatment has been a good deal disputed, and though there can be no doubt of the advantages derived from its use in cases of simple prostatorrhœa, the evidence in favour of its employment in spermatorrhœa is by no means conclusive.

T. PICKERING PICK.

SPHACELUS. *See* GANGRENE.

SPHINCTER ANI, Spasm of. *See* FISSURE OF THE ANUS.

SPICA BANDAGE. *See* BANDAGES.

SPINA BIFIDA.—*Definition.*—The term, first applied by Tulpus at the commencement of the seventeenth century, is used to define certain congenital malformations of the spinal canal, with prolapse of some of its contents, in the form of a fluid tumour.

Pathological Anatomy.—Most commonly this malformation affects the posterior segments of the vertebræ, and the tumour appears on some part of the back; but in a few cases the bodies of the vertebræ are found cleft, and the tumour then projects into the thorax, abdomen, or pelvis, between the lateral halves of the bodies affected. The tumour, at birth, varies very much in size—from that of a hazel-nut to that of a fist, and it may become very much larger. In form it is more or less hemispherical, its exact shape being largely determined by the size of the spinal fissure through which it issues; sometimes, the tumour is distinctly bi-lobed in its vertical axis; it may have a broad base, or be attached by a narrow pedicle, which may be either long or short. The tumour is usually situated in the median line, sometimes, however, with a little inclination either to the right or the left side; it usually occurs as a single tumour, but cases are on record where more than one tumour has been present. In St. George's Hospital Museum there is a specimen which, on the surface, appears to be constricted about its middle, and this constriction corresponds with a horizontal septum within, which separates two independent cysts. The sac is not infrequently multilocular, and in University College Museum there is a remarkable specimen of such a cyst; but there are no instances of two distinct tumours in any of the London museums. An occasional combination of spina bifida with congenital sacral tumour has been recorded.

The spine may be affected in any one of its regions. Demme records 57 personal cases, divided as follows:—5 cervical, 2 cervico-dorsal, 15 dorsal (two of which were instances of double tumours) 17 lumbar, 11 lumbo-sacral, 7 sacral. The writer's own cases, 19 in number, have all been lumbar or lumbo-sacral, with one exception, and this was at the sacro-coccygeal junction. Wernitz gives 210 collected cases (the above not included), with the following analysis:—Cervical 12, cervico-dorsal 3, dorsal 6, dorso-lumbar 9, lumbo-sacral 127, sacral 53. An examination of 125 specimens in various pathological museums gave the following results:—1 affecting the whole column, 9 dorsal, 9 lumbar, 68 lumbo-sacral, 21 sacral,

1 sacro-coccygeal, 3 dorsi-lumbar, 7 dorsi-lumbo-sacral, and 6 which could not be defined. It will thus be evident how largely the malformation affects the lower part of the spine—a significant fact when taken in conjunction with the relatively late period at which its development is completed. The anatomy varies considerably; the tumour may be a simple dilatation and protrusion of the spinal meninges (meningocele), or it may contain more or less of the cord and its nerves (meningo-myelocele), or it may be a dilatation of the central canal of the cord with prolapse of its membranes (syringo-myelocele). An analysis of the 125 specimens just alluded to showed that 10 were meningoceles, 79 meningo-myeloceles, 2 syringo-myeloceles; 19 were macerated specimens, and 15 were undeterminable or not dissected.

All these points are of importance, chiefly in prognosis, and as affecting the probable results of treatment. The cleft in the spine may involve all the vertebræ, or may affect but a single bone; more commonly three or four vertebræ are at fault. On examination, the spinous processes are absent, and the laminæ, more or less ill-developed, are found separated by the protruding sac. The sac may, or may not, be covered with normal skin; in the majority of the recorded cases of pure meningocele the skin is normal; it may also be normal in cases where the cord is intimately involved in the deformity. In the latter cases, however, more usually the skin surrounds the base of the tumour, and extends on to its surface for about half to three-quarters of an inch, and then becomes lost in the membrane which completes the sac. In a few cases, the membranous part of the sac corresponds with the extent to which the altered cord is adherent to the sac-wall. In others no such limitation exists. There is strong presumptive evidence, however, that this membranous area represents the attenuated neural tissue of the spinal cord from which the nerves within the sac really take origin. In St. Thomas's Hospital Museum there is a specimen of spina bifida in the dorsal region, in which the spinal cord, after blending with the sac-wall, may be found normally constituted in the lowest part of the sac, and in the entire part of the vertebral canal below the sac. This membrane is often white and glistening, like distended dura mater; sometimes it is red and inflamed; it may be so thin as to burst shortly after the child's birth, or strong enough to withstand considerable ill-usage.

Inside the sac there is a closely-fitting lining of arachnoid, so that the cavity of the majority of these tumours corresponds to the subarachnoid space. The pure meningoceles are more usually dilatations of the arachnoid cavity. The extent to which the cord enters the sac varies within considerable limits. If the deformity affects the lowest part of the spinal column, the cord will be less manifest, because here, at all ages, it is smaller in size than in other regions; when the cleft occurs in the lumbar region, then the cord, being larger, is more obvious. It will be remembered that the cord extends through the whole length of the spinal canal at the early period when spina bifida commences, so that there is nothing extraordinary in finding the cord even in a sacral spina bifida; and, in a very large proportion of the specimens preserved in the London museums, the cord, to a greater or less extent, is adherent to the posterior wall of the sac. In many cases a longitudinal furrow can be seen, giving the tumour a bi-lobed appearance in its vertical axis; in a few cases, as first pointed out by Virchow, and figured by him, there is a distinct depression or umbilicus corresponding to the insertion of the tip of the cord. In the former class, the cord passes out of the vertebral canal, and follows the curve of the tumour. In the latter, it passes more or less through the centre of the tumour to reach its posterior surface. Thus, the longitudinal furrow or the central umbilicus is, in some measure, evidence of the extent to which the cord is adherent; and whenever treatment is contemplated, it suggests that this median vertical portion of the sac, at any rate, must not be interfered with.

The spinal nerves belonging to the prolapsed cord arise within the sac, and pass forwards to their respective foramina; their anterior and posterior roots can usually be distinctly traced. They are sometimes found separated by a structure continuous with the ligamentum denticulatum, but far exceeding its normal proportion, which then forms a prominent falciform fold on each side of the middle line, corresponding to the interval between the anterior and posterior nerve-roots of either side. In some cases of sacral spina bifida, the spinal nerves arising from the cord within the sac, and even those arising from it above its entrance into the sac, take an upward course in order to reach their proper intervertebral foramina; this upward direction of the nerves is most common for the lumbar nerves. In the cases where the distended

central canal of the cord forms the interior of the sac, the nerve-arrangement varies a little; the sac, of course, does not contain any nerves, and it might hence be concluded that the case was one of simple meningocele. Dissection, however, shows the nerve-roots lying in the loose subarachnoid tissue between the innermost membrane and the other component layers of the sac-wall; they pass thence round the sac-wall towards their respective foramina of exit. The central canal, however, is sometimes larger than normal throughout the cord above the sac, in cases of spina bifida, without appearing to be involved in, or essentially connected with, the deformity.

Causes.—Early classical authorities are about equally divided in opinion between a primary dropsy of the central nervous system, interfering with the normal development of the spinal canal, and a primary arrest of development in the laminae of the vertebræ, allowing of prolapse of the nerve-centres and their membranes. There is little beyond conjecture in favour of the former hypothesis; and while it must be admitted that some arrest of development is found in most cases, there is at least one case in the College of Surgeons where no such arrest occurred. The association of other malformations—harelip, ectopia vesicæ, anencephalus, sacral tumour—doubtless speaks in favour of some congenital error in development as the most frequent cause, without, however, very clearly indicating in what the first step really consists. With regard to cases of pure meningocele, it seems not improbable that, owing to deficient development in the vertebral arches, and consequent lack of support, the spinal membranes prolapse in response to the increasing pressure of the cerebro-spinal fluid, or to its accumulation at the point of least resistance.

For the forms of spina bifida in which the cord and its nerves are attached to the sac, Cruveilhier advanced the opinion, previously foreshadowed by Morgagni, that the essential lesion is adhesion between the cord elements and the external skin. This opinion has since been independently put forward with much force by Ranke. Such an adhesion of the spinal cord with the skin cannot take place when the neural arches are once closed. The deformity, therefore, if this view be correct, must begin in the earliest period of foetal development—at a time, indeed, when the arches are still wholly undeveloped; that is to say, before the spinal membranes, the intervening structures, and the skin have been differ-

entiated. Hence, the error of development consists in the persistence of a foetal condition—a non-differentiation of blastoderm—rather than an adhesion in the more usual acceptation of the term. The formation of the sac (which is not an essential part of the deformity) proceeds automatically from the pressure of the cerebro-spinal fluid and the absence of adequate resistance. The cord, which is adherent to its membranes, together with the nerves arising from it, is displaced from the canal by the enlarging sac; they thus effectually prevent union of the vertebral laminae. The spinal nerves are necessarily elongated, and it is, perhaps, this condition which partly accounts for the varying degrees with which their functions are implicated.

Translucency of the sac is sometimes regarded as evidence of its purely fluid contents; but this is a very delusive diagnostic guide. In a case recently under the writer's care, the sac appeared quite translucent; but, after death, the cord was found within and adherent to the sac, and large nerves traversed it on their way towards their intervertebral foramina. Dr. Halliburton has favoured the writer with the following analysis of fluid taken from a recently treated case: Water, 989.75; solid matters, 10.25. These latter consisted of—extractives and soluble salts, 9.406; insoluble salts, .218; proteids (almost exclusively *globulin*), .842; sugar, .002. The composition of the fluid, according to Ranke, is:—.061 per cent. albumen out of a total of 1.06 per cent. solids; these yield 82.17 per cent. of their bulk, ash. This ash contains six-and-a-half times more soda than potash.

Diagnosis and Symptoms.—The diagnosis of spina bifida is not difficult. Given a congenital cystic tumour on some part of the vertebral column, and situated in the median line, the probability is very great that we have to deal with a spina bifida. Other cystic tumours may, undoubtedly, occur near the spine; thus, situated deeply, broad-based collections of fluid are sometimes met with, which Virchow and other authorities regard as sacs which have been gradually shut off from the spinal canal. Especially frequent in the sacral region, and extending towards the perineum, large pendulous sacs ('false spina bifida'), which have no connection with the spinal canal, are sometimes found. In many cases of spina bifida, a communication between the sac and the brain can be appreciated by alternately compressing the one and the other, the proceeding not infrequently

giving rise to spasm of the limbs, or to other signs of nerve-irritation. The sac varies in its tension; in a few cases it can be emptied. When the child's head is placed low, the sac relaxes; when the head is raised, it becomes more distended: the distension is influenced also by respiration, and by crying or other effort. In a few cases there is a distinct respiratory rhythm, synchronous with the pulsation at the anterior fontanelle. A young woman, with a very large tumour, recently seen by the writer, distinctly felt the wave of fluid between her spina bifida and the head. Many children with this deformity are born marasmic, with the lower extremities cold and atrophic, and sometimes quite paralysed. The sphincters of the bladder and rectum are also affected in many cases. This is presumptive evidence that the cord is involved. A post-anal dimple is often found associated with this deformity. When the sac is not very tense, the commencement of the cleft in the vertebral arches can often be felt, and is then an important factor in diagnosis. The writer knows of no symptoms by which the three varieties of spina bifida can be differentiated *with certainty* during life. A tumour situated high up on the spine, with a covering of normal skin, translucent, and having a narrow pedicle, will in all probability prove to be a meningocele; while a tumour on the lower parts of the spine, with a broad base and a membranous ulcerated sac-wall, accompanied by paralysis of the sphincters or lower limbs, will almost as certainly prove to be a meningo-myelocele.

Treatment.—A cure has not infrequently followed on spontaneous rupture of the sac, but death more often takes place. This is due to draining away of the cerebro-spinal fluid and to meningitis of a septic character, which gradually extends to the brain. The same occurs, too, after puncture in many cases. In all cases alike, then, in attempting treatment, the greatest attention must be paid to cleanliness and to prevent draining of the fluid. If the surface of the sac is ulcerated, still more when it is semi-gangrenous, a dry, absorbent, antiseptic dressing should be applied; and over this a moulded gutta-percha covering which, while it holds the dressing in place, will protect the tumour from injury. One of the most appropriate dressings is iodoform or salicylic wool; or, the tumour being well sprinkled over with iodoform, a plain wool dressing may be laid on. If the wall of the sac is very thin, but not actually ruptured, it is well to paint it

freely with collodion, in which a little iodoform has been dissolved; a thin layer of absorbent wool first laid on, and impregnated with the collodion, gives solidity and firmness to the sac-wall, and sometimes even suffices to cause the sac to shrivel up. This application should extend for some distance round the base of the sac. Such a protection frequently suffices to arrest the growth of the sac, if it does nothing else. Meanwhile, time is gained for the general health to improve, if it will. The frequency with which the spinal cord terminates in some part of the wall of the sac, and with which the spinal nerves pass through the sac, contra-indicates such methods of treatment as removal of the sac either with the knife or by means of a ligature around its base. Notwithstanding the fact that some cases treated successfully by these methods have been published, the remark holds good because of the impossibility of diagnosing cases in which the nerve-centres are not involved.

By far the most successful treatment is that proposed by Dr. Morton of Glasgow. He withdraws a portion of the fluid—'not more than half of the fluid contents'—and then injects a solution of iodine in glycerine (℞ Iodi gr. x., Potassii iodidi gr. xxx., Glycerini fʒj.). Of this 'from half a drachm to two drachms are injected, according to the size of the protrusion.' In the management of a case of spina bifida, among other points of importance Morton gives the following:—'The child should be in a thriving condition; the puncture should be carefully closed by collodion or otherwise, so as to prevent further escape of fluid; the parts must be gently handled and protected by the nurse; the injection is to be repeated if required.' Velpeau was the first to use iodine injections. He emptied the sac, and then injected some iodine solution, which was allowed to escape again after a short interval. A few successful cases, treated by other methods, may be found scattered through medical literature; but Morton's method is at present the most successful of any in vogue. In puncturing a spina bifida, always avoid the apex or membranous portion of the sac; puncture near the base, and select a spot where the skin is normal. The utmost that can be expected from treatment of such a serious malformation is a cure of the spinal protrusion. If paralysis exists, it will not be benefited by treatment; in a few cases, paralysis has come on subsequently; while very occasionally sudden death has followed interference. Hydrocephalus may

complicate the spina bifida, or appear as the cure of the spina bifida proceeds. Treatment should always be delayed for a few weeks—that is to say, until the infant's general health has had time to establish itself; palliative measures, such as the application of collodion, being meanwhile adopted to prevent the increase of the tumour. ROBERT WILLIAM PARKER.

SPINAL CORD. *See* BACK AND SPINE, Injuries of the.

SPINE, Diseases of the. *See* CARIES OF THE SPINE; LATERAL SPINAL CURVATURE; ANTERO-POSTERIOR SPINAL CURVATURE.

SPINE, Injuries of the. *See* BACK AND SPINE, Injuries of the.

SPIRILLUM.—A spiral thread-like organism, one of the SCHIZOMYCETES, the turns of which are arranged around a longitudinal axis. When the organism grows to a considerable extent, and secondary flexures are produced in its course, it has been termed 'Spirochæte.' This form of spiral organism has received the specific name 'denticola,' and is found in the mouth and nose and in dental abscesses. The most important spirillum is the *S. Obermeieri*, which is found in the blood of patients suffering from relapsing fever. It appears in the blood in greater quantity when the attacks of fever recur, and disappears when they vanish. The symptoms of relapsing fever have been communicated, from man to the monkey, by inoculating the latter animal with human blood containing the organisms (Carter).

Other spirilla found in stagnant water are *S. undulum* and *S. volutans*, the latter being a very large organism and provided with a flagellum on each end.

VICTOR HORSLEY.

SPLEEN, Diseases of the.—Certain of the diseases to which the spleen is liable are of interest to the surgeon, because it is now a well-established fact that the whole organ may be removed from the human subject in suitable cases, not only with safety to life, but with actual improvement to health.

The spleen may be dislocated, and pain may be produced by the resulting drag upon its vessels and nerves; it has even been found in the pelvis. It may be malformed, simply fissured or lobulated, or multiple. In the latter case, a number of little spleens may be found, merely attached to one another by their nerves and blood-vessels.

Dislocation, if accompanied by severe pain, may give rise to the question of oper-

ative interference, and possible malformation must be borne in mind in cases of doubtful abdominal tumour occupying the region of the spleen. Dislocated or wandering spleens have been twice successfully removed—once by Péan and once by Martin. Injury, simple hypertrophy, leukæmic hypertrophy, malignant hypertrophy (sarcoma or carcinoma), abscess, hydatids, and cysts, are the conditions which may raise the question of possible cure by operation.

INJURIES.—These may arise from incised wound, gun-shot wound, or rupture from direct or indirect violence, and there can be no doubt that in any case in which a clear diagnosis of either of these conditions can be made, and in which the symptoms indicate danger to life, the surgeon is not only justified, but bound to open the abdomen, and either to deal with the injury on general surgical principles or, if this be impossible, to remove the organ.

SIMPLE HYPERTROPHY.—This condition may be accompanied by softening or hardening of the organ, or it may retain its normal consistence. Endocarditis, syphilis, long exposure to malarial influences, intermittent fever, and ague are the common causes; but the spleen may be found enormously hypertrophied without any obtainable history of previous illness.

In this, as in other enlargements, it may form a tumour almost filling the abdomen and extending into the pelvis, so as to be mistaken for an ovarian or uterine tumour. Its upper part will, however, be found in its proper situation, and this, together with the notch, which can usually be distinguished, should prevent a mistake in diagnosis. The fact that the intestines do not lie in front of it, may help to distinguish an enlarged spleen from a renal tumour.

Zaccarelli of Naples is credited with the successful removal of an hypertrophied spleen, so far back as 1549; and in more recent times Péan, Volney d'Orsay, and Franjolini have each added a successful case to the records of this procedure. But against these at least an equal number of fatal cases must be recorded, and it remains an open question whether the deliberate removal of a spleen, simply because it is greatly hypertrophied, is a justifiable operation, unless it can be clearly shown that the condition is causing immediate danger to the life of the patient.

LEUKÆMIC HYPERTROPHY.—The enlargement in this case is so clearly only a part of a general blood-disease, which also affects other vital organs, that operative interference would be contraindicated, even with-

out the terrible list of failures which the records of splenectomy furnish. The leukaemic spleen has been excised in sixteen cases, and all the patients have died.

MALIGNANT HYPERTROPHY (Sarcoma or Carcinoma).—This is extremely rare as a primary disease, and is only of interest to the surgeon in so far as it is necessary to diagnose between the various forms of hypertrophy. The most ardent advocate for the operative treatment of cancer, would hardly include the spleen among the organs which it is advisable to extirpate for this disease.

ABSCCESS.—This should be treated by incision and drainage, and in the event of the antecedent inflammation not having caused adhesion between the spleen and the parietal peritoneum, great care should be taken to avoid any fouling of the peritoneal surfaces with the pus. The edges of the opening in the spleen should be accurately and closely sutured to those of the opening in the abdominal parietes, and the cavity drained and, if necessary, washed out from time to time with antiseptic solutions.

HYDATIDS should be treated in exactly the same way as abscess; suture, drainage and washing-out being employed, after the thorough evacuation of the small cysts and loose membranes.

CYSTS.—Cystic disease of the spleen, other than that arising from the presence of hydatids, is very rare; but both single and multilocular cysts have been met with, and the spleen has been successfully extirpated for cystic disease by Péan, Credé, and the writer.

SPLENECTOMY.—If complete extirpation be decided upon, the incision outside the rectus, recommended by Langenbuch for extirpation of the kidney, should be employed. The preparation of the patient and general procedure should correspond with that described in detail for OVARIOTOMY. The pedicle should be transfixed and ligatured in two or more portions, great care being necessary to avoid including a portion of the pancreas in the ligatures, and also to avoid the slipping back of any small vessel between the layers of the omentum, an accident which happened to the writer when removing an hypertrophied spleen, and which led to the death of the patient. If the ligatures can be applied before the tumour is turned out of the abdominal cavity, and therefore before the pedicle is put upon the stretch, it will be much easier to tie the ligatures securely and avoid the above-named accident; but with very large tumours this may be impossible.

Increase in the number of white cells in the blood, enlargement of lymphatic glands, enlargement of the thyroid, and anæmia have been said to follow the successful extirpation of the spleen, but were not observed by the writer in his case of successful extirpation for cystic disease; the patient recovering more slowly than after ovariectomy, and with more symptoms of disturbance about the pedicle than are common after the latter operation, but now enjoying the most perfect health.

J. KNOWSLEY THORNTON.

SPLEEN, Rupture of the.—A less common injury than rupture of the liver, it is generally complicated with other injuries of the abdomen and chest. The degree of rupture varies.

Causes.—Blows, kicks, falls, wheels of vehicles passing over the organ; penetration by fractured ribs; gunshot injuries.

Symptoms.—The nature and position of the injury received must be borne in mind, as there are no distinctive symptoms. There will be marked general shock, anxious countenance, coldness of the trunk and extremities, feeble pulse, sighing respiration; abdominal pain, especially over the seat of injury, dulness on percussion over the splenic area due to extravasated blood.

Prognosis unfavourable, as, owing to the vascularity of the organ, the hæmorrhage is generally severe; more so than when the liver is similarly injured. If the parenchymatous tissue be not very extensively torn, recovery may take place. In the surgical history of the American war three cases of recovery are recorded, two being the result of gunshot injuries and the third a bayonet wound. If the shock and hæmorrhage do not lead to an immediately fatal result, peritonitis and abscess are the complications to be feared. *See GUNSHOT WOUNDS.*

Treatment.—Rest in the horizontal position; warmth to the general surface of the body; ice, or warm fomentations, over the region of the spleen; morphia subcutaneously or by the rectum, to relieve pain. Brandy or egg-flip in teaspoonful doses at frequent intervals.

Should symptoms of internal hæmorrhage continue, no external wound existing, abdominal section at the edge of the left rectus muscle is to be recommended. If laparotomy shows that the hæmorrhage will not cease by exposure or the application of the thermo-cautery, the splenic artery may be ligatured or the spleen itself removed, either directly or by means of a ligature. This last procedure has been successfully

accomplished. All blood must be cleared from the peritoneum, and the abdominal cavity be thoroughly washed out with warm antiseptic lotion, carefully sponged dry, and closed after the introduction of a glass drainage-tube.

THOMAS F. CHAVASSE.

SPLENECTOMY. *See* SPLEEN, Diseases of the.

SPLINTS are surgical appliances used to maintain injured or diseased limbs at rest in accurate position, and to prevent or correct deformities. The materials used for splints are either rigid, such as wood or metal, or are capable of being moulded to the shape of the limb, such as leather, felt, or gutta-percha. Wooden splints are made of pine or deal boards cut to the required shapes and sizes. A very useful material for wooden splints is that known as Gooch's, or the 'kettle-holder' splint, which consists of strips of wood not quite separated from one another and glued on to oilcloth; it is flexible in one direction and perfectly rigid in the other, so that it is very useful when splints are required to surround a limb, as the thigh in fractures of the femur treated by extension. Metal splints are chiefly used for the lower limb: iron is the metal mainly used, and the splints, such as M'Intyre's and Arnold's, are made according to a fixed pattern and of various sizes, so that it is only necessary to select one of the proper size and pad it. Bars of malleable iron or telegraph wire make useful splints, either alone or in combination with wood or plaster of Paris.

If accurate adjustment to the shape of the limb is required, leather, poroplastic felt, gutta-percha, or house flannel soaked in plaster of Paris, must be used.

LEATHER SPLINTS.—A piece of stout sole-leather, of the required shape and size, should be steeped in a trough of cold water for about forty-eight hours, or until sufficiently softened; the addition of a small quantity of vinegar to the water used will shorten the time required for softening to four or five hours. The limb should be first bandaged with a flannel roller, and the softened leather applied and moulded to the limb and retained in position by a bandage for twenty-four hours, by which time the splint will have 'set' to the required shape; the splint must then be taken off, trimmed, lined, and fitted with eyelet-holes and laces.

POROPLASTIC FELT is made of two kinds—one, Hides', which is perforated with small holes, and the other, Cocking's, which is not. For most purposes the latter is preferable

on account of its greater strength. It consists of felt saturated with resin; it is light and porous; it is easily softened either in boiling water or before the fire, and it rapidly sets on cooling—properties which in the main render it more generally useful for splints than leather. Splints, partially moulded to the leg and other regions, can be obtained from instrument-makers. In these splints the bony prominences are well allowed for, so that it is a very easy matter to finish the moulding to a particular limb. Felt is undoubtedly the best material for spinal supports; it is lighter, more comfortable, easier to remove than plaster of Paris, and is quite strong enough for the purpose.

GUTTA-PERCHA is not porous, and on that account is not so comfortable to wear as leather or felt. It is quite easy to mould, but this requires a little care and experience. The water should not be too hot, or the gutta-percha will rapidly lose its shape, particularly if lifted out of the water by one end; the water used should be about as hot as the hand can momentarily bear. When sufficiently softened, the gutta-percha should be lifted out on a towel and plunged for an instant into quite cold water, which will cool it enough to be bearable by the patient, and will cause it to set enough to be easily manipulated without stretching, though not so much as to interfere with exact moulding. When partially set, the splint may be removed to quite cold water, in which it will rapidly set and harden. When moulding the splint, the bandage which is used to fix it in position should be wet, or it will stick to the softened gutta-percha.

MILLBOARD is not often used as a permanent splint, but, in combination with starched bandages, it is useful. Strips about four or five inches wide should be thoroughly softened in boiling water, steeped in hot starch solution, and then placed lengthwise along the limb outside a flannel or layer of cotton-wool, and fixed in position by a starch bandage. It is well to tear the half-divided strips of millboard, and to rub down the edges so that they may lie more comfortably against the limb.

Starch, plaster of Paris, paraffin, &c., may be employed to form immovable splints. *See* IMMOVABLE BANDAGES.

In the antiseptic treatment of compound fractures and excisions of joints, two methods are possible:—(1) To place the splint outside the dressing, or (2) to place it next to the limb and enclose it within the dressing. In the first method the splint is obliged to be taken off at each dressing—a pro-

ceeding which involves more movement of the fragments and more pain to the patient than is desirable; in the latter method there is the liability that the splint will get soiled with the discharges, which may decompose and lead to the failure of the antiseptics. The good points of each method may be retained, and the bad ones avoided, by the use of interrupted or bracketed splints. These consist of wood or metal splints applied to the limb above and below the wound, and connected by bridges of iron wire, which, while they maintain the rigidity of the apparatus, allow of the efficient antiseptic treatment of the wound being carried out beneath them.

A combination of plaster of Paris and telegraph wire forms a most satisfactory splint for the treatment of compound fractures and excised joints; in the manner about to be described, it has been extensively employed by the writer and found to be extremely efficient. The following description applies to a case of compound fracture of the humerus, in which the wound is about the middle of the outer side of the upper arm. The bone being held in position, and the elbow flexed at a right angle, the wrist and forearm should be bandaged with a flannel roller, and over this two or three layers of plaster of Paris bandage applied; similar bandages should be applied to the arm above the fracture, and be carried well over the shoulder. Pieces of telegraph wire should be cut and bent so as to form three rectangular splints accurately adjusted to the limb—an inner one reaching from the axilla to the wrist, an anterior one reaching from the front of the shoulder to the wrist, and a posterior one passing from the top of the shoulder to the wrist. The fracture being properly reduced, the wire splints should be applied and fixed by a turn of strapping above and below it, and then immovably secured by three more layers of plaster of Paris bandage. The edges of the plaster case, which bound the interruption above and below, should be trimmed. The three wires alone pass over the seat of fracture, and they stand off from the limb sufficiently to allow of the deeper part of the dressing being applied beneath them. But the apparatus, if used as described so far, is liable to the following accidents:—The blood-stained serum, which oozes from the wound, may trickle beneath the plaster of Paris case and decompose there, and the moisture alighting from the carbolic spray may sodden the bandages and weaken the splint. These objections are met by taking some melted beeswax and

paraffin (equal parts), soaking pieces of absorbent cotton-wool in it and carefully packing them between the limb and the borders of the plaster apparatus, and then painting these and the borders of the plaster apparatus—above and below the interruption, over a width of three or four inches—with the melted wax and paraffin mixture. The completed apparatus forms an immovable support, which allows of the strictest antiseptic precautions in the treatment of the wound.

The method described above was suggested by that employed by Mr. Howse in cases of excision of the knee. He employs a mixture of yellow wax and olive oil in such proportions as render the wax just soft enough to be applied cold without cracking; the mixture is warmed and bandages are passed through it, re-rolled, and allowed to cool. The limb is placed on the excision splint, and fixed by the waxed bandages; the intervals between the limb and the splint are next packed with pieces of absorbent wool soaked with the wax, and the whole apparatus is painted over with some of the hot wax mixture, so as to weld the bandages together.

PADS.—Splints should be well padded before they are applied. Pads may be made of tow or cotton-wool, packed together and wrapped up in soft cotton cloth, for which purpose old napkins or sheets serve very well. Cotton-wool alone is objectionable, as it tends to work into uncomfortable lumps, and, if used, it is well to sew through the pad here and there so as to prevent the wool shifting. A piece of tow wrapped up in a thin layer of cotton wool, and the whole covered by some soft cotton cloth, forms a good pad. Pads should be a little broader than the splint, so that the edges of the latter are well covered; and jointed splints should have separate pads for each piece, so that the angle of the splint may be changed without disturbing the pad. The pads should be fixed to the splint by stitches passing from one side of them to the other behind the splint, in the form of a lace-stitch. Sometimes, it is necessary to employ separate pads to relieve prominent points from pressure—e.g., when treating a broken leg on a back splint, a pad should be placed opposite the tendo Achillis, so as to relieve the point of the heel from pressure.

BILTON POLLARD.

SPONDYLITIS—Inflammation of a Vertebra. *See* CARIES OF THE SPINE.

SPONGE-GRAFTING. *See* GRAFTING.

SPRAIN.—The textures liable to this injury are ligaments, muscles, and tendons. As ligaments are mostly situated round joints, we usually speak of the latter as the parts injured. Those joints least liable to dislocation are most liable to sprain, and *vice versâ*. The joints most commonly sprained (in order of frequency) are the ankle, wrist, and knee.

Pathology.—A sprain is something more than the name implies. There is always more or less of rupture of fibres, blood-vessels, and sometimes of nerves. A sprain may be defined as a wrench of a joint, causing rupture of ligamentous structure without dislocation of the bones.

Symptoms and Diagnosis.—In order to describe the symptoms, sprain of the ankle may be taken as an example. The patient, in running, walking, or jumping, slips his foot, or comes down on the outer edge of it, so that it is forcibly *inverted*. (This is the most common method of infliction of the injury, because *eversion* is liable to produce Pott's fracture of the fibula.) The patient feels a sudden pain on the outer side of the foot; he may be conscious of something giving way (which would probably be the external lateral ligament); he may become sick or faint, and will probably fall to the ground. The ankle will swell at once, and the foot will be incapable of bearing the weight of the body. A person under the influence of excitement, or with a slight sprain, may be able to walk some distance, but soon the foot will become too painful for progression. Swelling comes on very rapidly, and is due at first to effusion of the blood and serum into the cellular tissue round the joint. There may also be effusion into the joint itself in severe cases. After a few hours, discoloration begins to take place from the effused blood, and it is astonishing how quickly the ecchymosis appears in some cases.

Certain complications which may occur will affect these symptoms. If the synovial membrane of the joint is injured, there will be effusion of blood and serum into the joint, as already mentioned, and, perhaps, subsequently synovitis. A blood-vessel of some size may be torn, when there will be considerable effusion of blood throughout the cellular tissue; or a nerve may be injured, when there will be severe pain, or numbness and powerlessness, of the parts beyond. Rupture of a tendon or muscle will also aggravate the symptoms. If a bone is broken, there will be crepitus, &c., and the case will become one of fracture complicated with sprain. If there is

dislocation of the joint, the deformity which results should be a sufficient guide in forming a diagnosis. In all cases of difficulty the position of the osseous prominences, and the presence or absence of deformity and crepitus, should be sufficient to decide by.

Treatment.—The writer has been in the habit of describing the treatment of sprains under four heads, viz: cold, heat, pressure, and massage.

1. Cold. If the case is seen early, cold water, or, better still, pounded ice in a waterproof bag, kept constantly applied, will prevent swelling and effusion, will favour the absorption of the blood already extravasated, will relieve pain, and will prevent inflammation. The secret of success in applying this method is to keep up the cold without any intermission. Two or three days of this treatment may be sufficient to let the patient get up and go about with a bandage on.

2. Heat. If considerable swelling has occurred, and some time elapsed before the patient is seen, then hot fomentations are very soothing. Absolute rest and warm applications having been maintained for some days, treatment by pressure or massage may be resorted to, in order to hasten the cure.

3. Pressure. This method may be employed at any stage of the treatment of a case of sprain. After some days of cold or hot applications, a firm bandage, wet or dry, or, better, carefully applied straps of adhesive plaster, will afford support to the weakened limb, and will promote the absorption of the effused blood and serum. But the way in which pressure is most beneficial is when applied at the very first. It then *prevents* swelling and effusion, and, if combined with some immovable apparatus, as lateral splints with starch bandaging, or plaster of Paris, the patient may be able to go about. The great point in employing this method is to apply the bandage *evenly*, with no undue pressure at any point. The following is a safe and comfortable apparatus:—Let two pieces of thick flannel be cut the shape of the foot and ankle (or wrist), large enough to meet behind and in front (they had better be double for the ankle). These should be soaked in a thin mixture of plaster of Paris, and firmly and evenly bandaged on. When they have set, which they will do in a few minutes, they may be removed, padded, if necessary, and re-applied.

4. Massage. This method consists, as is well known, of a combination of rubbing,

kneading, and movement of the part. *See* MASSAGE. Such procedure is, of course, totally opposed to the principle of *rest*. The theory of its beneficial action is that it promotes absorption, and prevents adhesions and contractions. Massage is useful in two ways. It may be employed from the first in slight sprains, and in severer ones is very beneficial, if employed after a week or ten days, in restoring the injured parts to their natural appearance and functions.

After-treatment and Results. — It should never be forgotten that there is truth in the popular saying that a neglected sprain is worse than a broken bone. When one remembers what structures are torn, one easily sees how their non-union or improper union will leave a permanently weakened or disabled limb. It comes to be an important question, therefore, 'how long ought treatment of a sprain to be continued?' The writer would say that for a severe sprain three weeks of rest will be necessary. But the best guide, which will apply to all cases, is disappearance of all swelling, and capability of moving the joint freely without pain. If these indications are fulfilled, then there can be no difficulty in pronouncing the patient cured, and the limb fit for use. But, unfortunately, such a result is not always obtained; even after several weeks of treatment, the joint may be swollen and stiff, or painful and weak. This is usually the result of one of two things—either the joint has been kept too long stiff, or the patient has been using it too much. In either case, a course of massage is usually beneficial, combined with warm or salt-water bathing. But there are other more serious and permanent results that may follow a badly-treated sprain. A *ganglion* may appear, connected with a tendon-sheath or a joint, and associated with permanent weakness of the part. A more serious event is the occurrence of disease of the joint. The history of a scrofulous joint often commences with a severe sprain.

A. G. MILLER.

STAFF. *See* LITHOTOMY; BOUTONNIÈRE, the Operation of; BUCHANAN'S RECTANGULAR STAFF.

STAPHYLOMA. *See* CORNEA, Variations of Curvature of the.

STAPHYLORRHAPHY. *See* CLEFT PALATE, The Surgical Treatment of.

STASIS. *See* INFLAMMATION.

STEATORRHŒA. *See* SEBORRHŒA.

STERILITY IN THE MALE.—An incapacity for procreation. It may be the result of absence of spermatozoa from the seminal fluid, or of absence of any seminal discharge during coition. The former is designated Azoospermism, the latter Aspermatisism.

Temporary azoospermism is sometimes caused in persons of naturally feeble power by excessive indulgence in venery or by masturbation. Abstinence from all erotic excitement speedily restores the functional activity of the glands in these cases.

Idiopathic azoospermism is a very rare affection. It occurs in young and vigorous adults, in whom no physical defect can be discovered. They have all the external signs of virility, can copulate and have emissions with the normal pleasurable sensations, but the seminal fluid never contains spermatozoa. The writer has recently had under his care an instance of this affection. A gentleman aged 40, vigorous and healthy, had been married for several years but had no children. His sexual appetite was normal, and coition was always attended with an abundant ejaculation and normal sensations. His testicles were large, firm, and sensitive to pressure, and no abnormality could be discovered in the efferent passages. He had never had epididymitis. His semen, examined on three occasions, with an interval of some months between each examination, was always devoid of spermatozoa. It was perfectly normal in appearance, but microscopically disclosed many epithelial scales, molecular fat, and crystals of triple phosphates. No explanation of this condition has as yet been discovered.

Usually azoospermism is due to defect or disease of the testicles, or to obstruction of their efferent ducts. Atrophy of both glands, from accident, disease, or mal-nutrition, must produce this condition. Cryptorchism has generally the like result. Cases have been recorded of apparently successful procreation by the subjects of bilateral cryptorchism. But in the absence of microscopic demonstration of spermatozoa in the semen of such persons, or of dissection disclosing a normal condition of the glands, some doubt must be entertained, for the examination of such retained testicles has almost invariably revealed an absence of the ordinary glandular structure.

Obstruction of the efferent ducts will also cause azoospermism. This may be congenital, but is more usually the result

of gonorrhœal epididymitis or of tubercular deposits. Sometimes tumours of the prostate gland may cause obstruction of the vasa efferentia before their junction with the vesiculæ seminales. Aspermatisms may be caused by some obstacle to the discharge of the seminal fluid, or may be of nervous origin. Very tight phimosis, or a very small urethral orifice, such as usually exists in intermediate cases of hypospadias, where the urethra opens on the under surface of the penis and a little behind the glans, may produce retention of the seminal fluid. Urethral strictures may have the like result, even when no difficulty in micturition has been experienced. If the stricture be situated anteriorly, the semen is retained in the urethra and voided after erection has subsided; but if the stricture be far back the semen usually passes into the bladder, and spermatozoa are found in the urine. But the obstacle may be in the ejaculatory ducts, when there will be either no discharge whatever during coition, or only the scanty secretion of the prostatic, Cowperian, and urethral glands. Cicatricial formations in the prostate, resulting from inflammation or suppuration or prostatic calculi, may produce this condition. Lateral lithotomy is said to sometimes have the same result.

But aspermatisms may be of nervous origin. As ejaculation is a reflex act, so the afferent or efferent nerves or the nerve-centre may be the cause of failure. Thus, deficient sensibility in the glans penis, from cicatrices or induration, has sometimes caused it. Sometimes there is a history of incontinence of urine in childhood, which suggests the possibility of some atonic condition of the muscular apparatus for ejaculation. As physiology has not yet demonstrated the existence of a distinct ejaculatory centre, the pathological affections of it, if any such exist, are unknown.

But aspermatisms may be of psychological origin. This form may be permanent or temporary, complete or partial. Some persons are said to have had sexual desire and erections, but never to have had ejaculations while they were awake, while during sleep they have had abundant emissions of normal semen. Such cases can only be explained by the assumption of some inhibiting psychological influence. Minor degrees of this have been described where the inability was limited to intercourse with one individual, or was only of temporary duration.

Treatment.—Azoospermism, unless as the temporary result of exhaustion of the glands from excessive venery, is practically incurable in the great majority of cases.

Hence, acute inflammation of the testicles or epididymis, and syphilitic orchitis should be promptly and suitably treated, for speedy resolution of the inflammation and absorption of the syphilitic deposit afford the best chance of functional recovery of the glands and maintenance of permeability in the efferent ducts. Aspermatisms due to phimosis or stricture may be cured by circumcision and dilatation. Obstruction of the ejaculatory ducts is not amenable to treatment, but nature sometimes bursts open the opposing barrier during coition. When the sensibility of the glans penis is deficient, blistering the part and galvanism have been of service in some cases, but have been ineffectual in others. In atonic aspermatisms the extract of nux vomica or Easton's syrup is useful. The psychological variety of aspermatisms occurs so rarely that little is known about it. Possibly the repeated application of the constant current to the lower part of the spine and neck of the bladder might prove useful. JEREMIAH M'CARTHY.

STERNUM, Fracture of the.—Fracture of this bone by itself is of exceedingly rare occurrence, but it is more common when associated with that of other bones, as of the ribs or spine, especially in accidents of a crushing or compressing nature. It is also said to be produced occasionally by muscular action, as in the straining of parturition, when the patients have arched their bodies strongly backwards in the act of delivery. Fracture of the bone may also be produced by bending the body, either backwards or forwards, over a projecting angle. In the former case, the fracture is produced by indirect violence; the parts of the sternum getting torn asunder by the strain put upon them. In the latter case, the injury may be either produced by the direct action of the projecting angle, or the sternum may get so doubled in on itself as to break.

Fractures of the sternum may be either transverse, oblique, or longitudinal. Of these, the two former are by far the most common. The so-called dislocations of the sternum may be most fitly considered here with the fractures of this bone,—the signs of the lesion, the symptoms following it, and the effects being similar in the two cases. The only dislocation of the sternum at all frequently seen is that between the manubrium and the gladiolus, and even this is not common.

The causes producing both fracture and dislocation are the same. There is generally considerable deformity, produced by the overlapping of one fragment upon the other.

The lower fragment is generally found to be the one most in front. Reduction of the deformity is most difficult, though it has been accomplished by manipulation in a few cases. If the surgeon should be successful in this, the attempt may be made to keep the fragments in position by pads, strapping, and bandages. It will, however, generally be found that the effort is futile, the deformity being reproduced on a change in the patient's position.

Other symptoms of these lesions will consist in pain at the seat of separation, increased by efforts at respiration, especially those of the forced kind, such as sneezing or coughing. These injuries to the sternum are frequently complicated by laceration of the pericardium or pleura. In such cases, the symptoms will be those of the more important injury, and will be found treated of in the articles PERICARDIUM, Wounds of the; LUNG, Wounds of the; HÆMOTHORAX, &c.

The prognosis in an uncomplicated case of fracture or dislocation of the sternum is very favourable. In complicated cases the mortality is high, and the prognosis will depend upon the organ injured.

H. G. HOWSE.

STINGS OF INSECTS. — In this country, the stings of bees and wasps, and in tropical countries, besides these, the bites of spiders, centipedes, and scorpions may be attended by unpleasant consequences.

BEES AND WASPS. — As a rule, nothing more than local swelling and pain follow the introduction of the poison, and the severity of these effects depends a good deal upon the general condition of the individual. The sting sometimes remains in the wound, and must be extracted. This and the local application of some cooling lotion or powder are usually all that is necessary. The sting of the bee will sometimes give rise to serious general symptoms, and even prove fatal; but it appears, from a study of several cases, that these unusual results are determined largely by a predisposition on the part of the individual. In two cases, of which one proved fatal, it is noted that the ordinary local swelling did not occur, and, as both patients had frequently been stung before with the usual local effects, it is suggested that the poison entered a vein directly. The poison, when it produces a general effect, does so within a few minutes, leading to faintness, vomiting, diarrhœa, dyspnœa, and unconsciousness. Recovery may take place in an hour, or the patient may remain feeble for days, or death may result from

cardiac failure. When the sting is inflicted in the mouth or pharynx, there is danger from œdema of the glottis. Such a result, ending fatally four hours after the injury, is recorded as occurring in a man aged twenty-four.

SPIDERS. — The bite of the katipo or poison spider, of New Zealand, is the most serious in its effects. A local swelling of large size and of a white colour is produced; the patient in one case became faint and pulseless, cold and flaccid, but rallied after the free use of ammonia and brandy. The most peculiar effect of the poison appears to be the production of a low and feeble state of health, which may continue for six weeks or three months. The spider has a dark glossy body, with a marked red spot on its back. Another variety without the red spot is also described. The insects inhabit the sandy beaches, and shelter amongst the drift-wood and sedge.

CENTIPEDES AND SCORPIONS have special hooks for purposes of attack, connected in the former with the mandibles, and in the latter with the terminal abdominal segment. Only the bites of the larger centipedes are serious, and the effect seems to be purely local, so that probably no poison is introduced. The hooks of the scorpion are perforated and connected with poison-glands, and the symptoms resemble those described as occasionally following the stings of bees — viz. numbness, vertigo, vomiting, &c. Locally there is acute swelling, followed in many cases by suppuration, sloughing, and their consequences.

Treatment. — The local and general effects being much the same in all, the treatment also will be similar. Where possible, a ligature should be tightly applied above the wound, the puncture sucked or otherwise treated, and afterwards the ligature slowly relaxed, constitutional treatment being employed as symptoms develop. Locally, the application of cold at first, and, if inflammation occur, of warmth by means of poultices, &c. In the case of spiders, a crucial incision has been made with good effect, and afterwards a strong antiseptic might be applied. Freestimulation by means of ammonia and alcohol should immediately be resorted to in cases where there is any faintness, and their timely administration has no doubt saved many patients, for the effect of the poison, in the majority of instances, is of short duration.

CHARTERS J. SYMONDS.

STOMACH, Cancer of, and Treatment.
See GASTROSTOMY; PYLORUS, Operations on the.

STOMATITIS.—The inflammatory lesions which may affect the mouth are as follows—(1) catarrhal; (2) follicular; (3) aphthous; (4) ulcerative; (5) gangrenous; (6) mercurial; (7) parasitic, and (8) syphilitic stomatitis.

1. **CATARRHAL STOMATITIS.**—*Causes.*—*a.* Dentition. The disease is most common during the period of eruption of the milk teeth, between the ages of six months and two years, but may also appear in connection with the second dentition, between the ages of six and thirteen years, or even in early adult life, at the time of the eruption of the wisdom teeth.

β. Local irritants. Improper food, abuse of alcohol or tobacco, carious teeth, accumulation of tartar, &c.

γ. Disturbances of the digestive tract, primary or in association with general disease. In this case the complaint seldom falls under the notice of the surgeon, unless the causative condition be masked by the local lesion.

Symptoms.—The onset is marked by a temporary diminution of the secretions of the mouth, while the mucous membrane becomes dry, hot, and tumid, and is beset with bright red patches which quickly spread, and by coalescence form a diffused blush over the whole of the cavity. The saliva is scanty and tenacious, the sense of taste is vitiated or lost, mastication and deglutition are painful, the breath becomes offensive owing to decomposition of the secretions, and the patient may be annoyed by subjective gustatory sensations of a more or less disagreeable nature. At the end of a few hours, the secretions are restored and soon become excessive; the mucous membrane becomes redder and more swollen, and presents deep indentations at the points of contact with the teeth; the epithelium becomes thickened and cloudy in places, and may here be detached, leaving superficial erosions; and finally, in severe cases the borders of the gums may ulcerate and the teeth become loosened. The course of the disease is usually mild, the symptoms passing away within a few days; but occasionally it may defy treatment for several months.

Treatment.—It is seldom necessary to adopt any special treatment for the milder forms of the disease, beyond attention to the probable cause and to the regulation of diet. In the more severe cases, the use of detergent washes (chlorate of potash, borax, &c.), ice to suck, and the administration of bark and other tonics, will hasten the progress of recovery. In the rare examples

of chronicity, perchloride of iron in large doses (one to three drachms three or four times daily) may be found efficacious.

2. **FOLLICULAR STOMATITIS** is marked by an eruption of red papules surrounded by inflammatory areolæ, and developing apparently in connection with the mucous glands of the lips and cheek. The points generally soften and burst, leaving small excoriations, which soon heal.

3. **APHTHOUS STOMATITIS** is a disease that offers a certain resemblance to the parasitic stomatitis or 'thrush,' both in appearance and course, but is less superficial and does not present the same fungus on microscopical examination. It is characterised by the appearance of disseminated whitish or yellow patches of sub-epithelial exudation, which give place to superficial excoriations, and it may be associated with febrile disturbance, and in some cases with vomiting, diarrhoea, and other manifestations of digestive disorder. This and the last variety of stomatitis usually appear under the same circumstances as the ordinary catarrhal form, and are amenable to the same treatment.

4. **ULCERATIVE STOMATITIS.**—This is a more specific and troublesome affection than the catarrhal form, and is marked by a fairly definite localisation of its principal lesions, and an almost absolute limitation to two eras of life.

Etiology.—The causes are twofold: on the one hand, *constitutional debility* mainly induced by impure air and improper or insufficient food; and on the other, *local irritation* in association with the eruption of the permanent teeth. It is, hence, almost peculiar to the children of the poor between the ages of six and twelve, or to young men between eighteen and twenty-five who are placed under unfavourable hygienic conditions, as in barracks, hospitals, &c. In either case it may assume an epidemic form, but there is no satisfactory proof that it spreads by contagion.

Symptoms.—The earliest sign is, usually, a fetor of the breath with a sense of heat and tenderness of the gums. The saliva is at first diminished in quantity, but soon becomes profuse, opaque, and offensive. The whole of the buccal membrane becomes red, swollen, and hyperæsthetic, the gums are exquisitely sensitive and bleed at the slightest touch, the teeth loosen, the submaxillary and sublingual glands become enlarged and slightly tender, and the movements of the jaw are so painful that mastication becomes intolerable. On examination of the mouth, the affection is found

in most cases to be unilateral (more frequently attacking the left side), the gums are dusky red or purple, swollen, ulcerated, especially where in contact with the molars, and covered with a greyish pultaceous material consisting of epithelial débris and altered secretion admixed with pus and blood, and containing countless bacilli. The mucous surface of the cheek, opposite to the ulcerated gums, usually presents a whitish oval patch of altered epithelium or an ulcer left by the detachment of the morbid tissue, and this lesion may become continuous with that of the gum by meeting it near the last molar tooth. The tongue, in like manner, may present a white patch or a superficial ulcer opposite to the same point; and, lastly, disseminated areas of a similar character may appear upon the palate, pillars of the fauces, and tonsils, where they may possibly be mistaken for mucous tubercles. It must be noted that the ulceration is not associated with inflammatory induration of the contiguous tissues, as in *cancrum oris*.

The course of the disease is usually favourable under treatment, but in very severe cases it may end as in *Mercurial Stomatitis*.

Treatment.—The essentials for recovery are pure air and good food. The diet should be in a fluid form, as nutritious and assimilable as possible, and may be carried to the back of the pharynx through a tube, if direct contact with the mouth induce much suffering. Pancreatic emulsion is a useful adjunct in many cases, and other articles of food may be artificially digested before administration. Nutrient enemata may be employed where the demand for support is urgent, and sufficient nourishment cannot be introduced by the ordinary channel; tonics in the form of the preparations of bark and iron are often valuable. Local applications of nitrate of silver or powdered alum to ulcerated surfaces, and the frequent use of stimulant washes (chlorate of potash, 20 grains to the ounce, &c.), may be recommended. The mouth should always be cleaned after food.

5. GANGRENOUS STOMATITIS. See CANCRUM ORIS.

6. MERCURIAL STOMATITIS.—This once common disease is now rarely seen in its more acute forms. It may occur, as heretofore, during the administration of mercurial preparations, especially where there is any natural or acquired susceptibility to the action of the drug; or in connection with industries involving frequent contact with the metal; but the exercise of more ade-

quate precautions in the latter case, and the influence of therapeutic progress in the former, have almost transferred the complaint to the list of pathological curiosities.

Symptoms.—The onset of mercurial ‘salivation’ is usually announced by a dry burning sensation in the mouth, a nauseous metallic taste, tenderness of the gums, and fetor of the breath. The salivary secretion soon becomes increased, and may at length pour from the mouth in immense quantity, even to the amount of several pints in the course of twenty-four hours; the fluid is thin and offensive, and the presence of mercury may be detected in it by chemical tests. The gums swell, assume a purplish tint, and may ulcerate; the teeth become loose and tender, and coated with a greyish pultaceous material of repulsive odour; the whole buccal membrane becomes inflamed, and covered with whitish patches of proliferating epithelium. The salivary glands and the submaxillary and retromaxillary lymphatic glands enlarge, and the swollen tongue may protrude from the mouth. Extension to the Eustachian tube may induce deafness, and the implication of the arytaeno-epiglottidean folds may give rise to suffocative symptoms. Finally, the inflammatory processes may assume a destructive character, leading to extensive gangrene of the mucous membrane; and at length the patient, worn out by suffering and imperfect nutrition, sinks into fatal adynamia.

The duration of the disease is very variable even under the most active treatment. In ordinary cases a cure may be effected within a few days, but occasionally the resources of the surgeon are baffled for weeks.

Treatment.—The general principles of treatment are the same as in ulcerative stomatitis. The most active remedy in the mercurial form is chlorate of potash, which often exerts an almost magical influence over the local lesions. It may be used in the form of lotion (20–30 grains to the ounce), and given internally in association with hydrochloric acid and bark. Sulphurous baths have been recommended, with a view to hasten the elimination of the poison from the system.

7. PARASITIC STOMATITIS or THRUSH is a disease caused by the growth of a fungus, called the *oidium albicans*, in the buccal epithelium. It seldom appears as an independent affection, but more often arises as a complication in the later stages of chronic exhaustive maladies.

It commences with the appearance of little whitish spots upon a reddened base

about the angles of the mouth; these enlarge and coalesce to form milk-white superficial patches of considerable extent, which may eventually spread over the whole buccal cavity and the passages communicating with it. If the complaint be a symptomatic development in the course of other diseases, no special changes are observed in the pre-existing constitutional symptoms; but where it arises *de novo* it is usually preceded by febrile disturbance, and may be accompanied by vomiting, diarrhoea, and other signs of disorder in the digestive tract.

The patches, on examination, are found to consist of epithelium permeated by the spores and filaments of the fungus.

The general *treatment* is directed to the improvement of health and the relief of any digestive disturbance that may be present. Nitric acid is of value as a tonic. As local applications, glycerine of borax, powdered alum, and chlorate of potash are the most serviceable medicaments.

8. SYPHILITIC STOMATITIS.—The syphilitic lesions of the mouth are—(1) those of the early secondary period, a transient erythema, mucous tubercles, and superficial sores resulting from the latter; and (2) the gummatous infiltrations of the later stages, which tend to break down into ulcers. The affections may assume special characters in the TONGUE and PALATE.

An erythema of the mouth and throat is commonly associated with the earliest cutaneous eruption, but is generally of trifling severity and short duration, and calls for no special treatment.

Mucous tubercles show themselves in the early months of the disease. They appear as flat or slightly prominent opaque greyish patches, which by detachment of the affected epithelium may become converted into irregular excoriations. The angles of the mouth, the tongue, tonsils, and pillars of the fauces are the most frequent points of attack, but the lesion may involve any portion of the buccal membrane. See MUCOUS PATCHES.

This affection, so quickly amenable to treatment in most other situations, is apt to be excessively obstinate when established in the mouth, probably owing to the irritation kept up by the normal and abnormal secretions, by the passage of food, and by the constant movements of the affected part in speech, mastication, and deglutition. The best local measures of treatment are cleanliness, careful selection of diet, and the occasional application of nitrate of silver in stick or solution.

The gummatous infiltrations may be roughly divided into 'superficial' and 'deep;' the former confined to the mucous membrane, the latter extending into the subjacent tissues. In either case the lesion, as a rule, is primarily manifested by a tubercular prominence, but may sometimes assume a more diffused character, as in the 'sclerous glossitis' of Fournier. See TONGUE, Diseases of the.

The gummata are always destructive in tendency, and may lead to deep ulceration in the soft parts, or to necrosis where the bony walls of the mouth are attacked, and leave permanent and often unsightly scars.

The *diagnosis* of syphilitic ulcers of the mouth is of more particular interest when the tongue is the seat of disease, but the distinction of the specific lesion from non-specific ulcerations and from epithelioma must be borne in mind, in the investigation of all parts of the cavity.

The characters of ulcerative stomatitis and tubercular sores have been dealt with elsewhere and should offer no difficulties of diagnosis, but it is sometimes by no means easy to arrive at the far more important decision between malignant and gummatous ulcers. As a rule, the tertiary ulcer is marked by the absence of glandular enlargement, the comparatively slight induration of its base and borders, relative freedom from pain, its frequent localisation in situations not exposed to direct irritation by carious teeth, &c., and by the age and history of the patient. But age, history, and locality in certain cases fail to afford any guiding indications. A syphilitic sore is occasionally painful and indurated, and there may be some irritative enlargement of the submaxillary glands; while, on the other hand, an epithelioma in its early stages may cause no suffering, and may be long unassociated with any perceptible glandular implication. In cases of doubt, the examination of a fragment taken from the surface of the ulcer, and the tentative administration of rapidly increasing doses of iodide of potassium, will often provide a solution to the problem; or the sore may be scraped with a curette, a plan that may enable the surgeon to arrive at a positive conclusion without prejudice to further treatment. It must, however, be remembered that a syphilitic lesion is a not infrequent nidus for the development of malignant disease, and that it is hence unadvisable to temporise too long with a suspicious ulcer that resists all the appropriate treatment for the milder affection.

The constitutional treatment of the later syphilitic diseases of the mouth is that of SYPHILIS in general. Locally, there is little to be done beyond the exercise of the precautions mentioned in connection with mucous tubercles.

WILLIAM ANDERSON.

STONE IN THE FEMALE BLADDER.—Stone is much less frequent in the female than in the male, the proportion in the Norwich Hospital being about 1 to 19. It is usually of phosphatic structure, and its nucleus is often formed by some foreign body, such as a hairpin, a portion of catheter, or of bone or vegetable substance. Sometimes it attains a very large size, and has been known to interfere seriously with parturition. When small, the calculus may escape unnoticed by the urethra, and sometimes it is discharged by vaginal ulceration. In the museum of the Norwich Hospital there is a collection of 3,000 calculi, which were passed by a lady during three years and a half. In the same collection there is also a stone weighing six ounces, which was spontaneously extruded from the female bladder.

The *symptoms* are similar to those of stone in the male bladder, and the diagnosis is seldom attended with any difficulty. Exploration should be made with a short and almost straight sound, or with an ordinary female catheter. In cases of difficulty, the finger should be placed in the vagina and, at the same time, pressure be made to bear upon the bladder above the pubes. The stone, if large, may often be thus detected.

The usual methods of treatment are dilatation of the urethra, lithotrity, and lithotomy.

DILATATION.—The female urethra may be readily dilated by Weiss's three-bladed dilator, or by gently introducing the little finger, or a large sound or bougie. Gradual dilatation of the canal may be effected by the use of a sponge-tent or a stem of laminaria, but it has been found that the rapid method is less liable to be followed by incontinence of urine. A suitable pair of forceps is then introduced, and the stone extracted. Dilatation may be assisted by incision of the mucous membrane of the urethra. Except in cases of very small stone, dilatation, with or without operation, cannot be considered a suitable operation, as it so often results in incurable incontinence, due either to over-distension of the urethral walls or of the sphincter of the bladder.

LITHOTRITY is the most satisfactory operation in cases of stone in the female bladder, since calculi may be crushed or removed at one sitting at least as readily as in the male subject, if not more so, and the convalescence, as a rule, is more steady, certain, and rapid. The objection to this operation that it is difficult to inject much fluid into the female bladder has, at the present day, lost much of its importance. By the use of a short and specially devised lithotrite, a stone of moderate size may be readily seized and crushed into small fragments, which can either be removed at once by forceps or by a suction apparatus, or be left for expulsion in the stream of urine, which is more free and forcible in the female than in the male.

LITHOTOMY.—The stone may be removed by making an incision through the floor of the urethra on a grooved staff (urethral lithotomy), or more directly through the anterior wall of the vagina (vaginal lithotomy), the edges of the wound in each case being brought together by fine metallic sutures, and a catheter being retained in the bladder. The chief risk of lithotomy in the female, whether urethral or vaginal, is failure of union between the edges of the wound and consequent formation of a fistula. The operation, though much less formidable than lithotomy in the male, is not indicated except in cases of large and hard stones that cannot be crushed.

If the stone be very large, so as to occupy most of the cavity of the bladder, the only method of operative treatment likely to prove successful would be supra-pubic lithotomy, the difficulties and dangers of which might be much diminished by attention to antiseptic details and by distension of the vagina. See LITHOTOMY. T. W. CROSSE.

STONE IN THE MALE BLADDER. The children of the poor, and elderly members of the well-to-do classes, are the chief sufferers from vesical calculus; it is seldom found in children of parents in comfortable circumstances, and rich men are more prone to the disease than poor men. Before discussing the special symptoms of stone, it may be remarked that it is very suggestive of the presence of a calculus in the bladder, if the patient who complains of painful and frequent micturition has previously passed a number of stones, and now congratulates himself that he cannot be suffering from a calculus, since he has passed none for some time.

Symptoms.—1. *Pain.*—This is usually the most prominent symptom. The patient

complains of pain in passing water. It is most severe at the close of micturition, when the bladder is empty, and is usually felt at the end of the penis, about an inch from the external meatus. The pain disappears as urine gradually collects again in the bladder, and separates the stone from the sensitive walls of that organ. It is described as a shooting, throbbing or aching pain, and is accompanied by much involuntary straining in which the rectum often participates, causing the evacuation of its faecal contents, or the protrusion of piles if any exist. Pain is felt if the patient is jolted over a rough road, or shaken in any way. Riding on horseback often causes the first symptoms noticed, and brings the sufferer to the surgeon. Stooping is often found to cause pain.

2. *Blood in the Urine* is generally the next symptom which attracts notice. After exercise, especially, the urine is likely to be tinged with blood. Sometimes the urine is passed apparently free from blood to the naked eye, until the final part of the stream, which may be red; and at the very last a drop or two of pure blood may pass. The hæmaturia comes on gradually. Sudden and well-marked hæmaturia is not characteristic of stone. Rest generally causes bleeding due to stone to disappear.

3. *Frequency of Micturition*.—As a rule urine has to be passed oftener than usual. When moving about, the patient finds he has to make water more frequently than when sitting quietly in his easy-chair. When in bed at night, micturition is less frequent than in the day-time. If these facts are elicited, they will be strong evidence of the presence of stone in the bladder.

4. *Sudden stoppage in the flow of Urine*.—This symptom is mentioned in most books on stone, and is, therefore, referred to here, but it is in reality rarely observed. When it does occur, the stoppage is due to the stone getting into, or falling over, the vesical orifice of the urethra.

5. *'Attacks of the Stone.'*—The bladder may carry a large stone without producing many symptoms, because the calculus has made a nest for itself from which it rarely moves. When, however, it is disturbed, as after unusual exercise or shaking, severe symptoms may suddenly appear. There will be frequent desire to pass water, accompanied by straining and much pain, and the urine will contain blood and mucus. Such a condition is called 'an attack of the stone.' Rest and fomentations generally suffice to make these symptoms disappear

for a time, only to return with increased vigour when fresh provocation is given.

6. *Condition of the Urine*.—The urine is usually cloudy from muco-pus; but perfectly clear urine is not incompatible with the presence of a large stone in the bladder.

In boys the symptoms are much as just described. Micturition is painful, and the child cries and tries to relieve his suffering by pulling at his foreskin, which is long and reddened from constant manipulation. The right thumb and forefinger may be found in a sodden condition from their frequent contact with urine. The bowel is constantly protruded, and genuine prolapse of the rectum is not uncommon.

Differential Diagnosis of Vesical Calculus.—The symptoms of stone in the bladder must be distinguished from those of many of the diseases of the urethra, prostate, bladder, and kidney. In stricture of the urethra, any pain there may be in passing water is during the act and not afterwards. In hypertrophy of the prostate, pain is felt before water is made. In tumours of the bladder, the bleeding is more profuse than when caused by stone. Portions of tumour-débris may also be detected by the microscope in the urine. Tubercle or calculus of the kidney can only be diagnosed by a process of exclusion, after an instrumental examination has been made. It may be accepted, as an axiom, that no surgeon can say, from a patient's symptoms, whether or not he has a stone in his bladder without sounding him; and it may be added, no patient should be sounded for stone unless he has at least some of the symptoms, or until the following simple physical examinations have been made.

Passage of a Catheter.—After the patient has made all the urine he can by his own efforts, a soft catheter is immediately introduced. The instrument will at once detect any stricture of the urethra or calculus in that canal. If atony or paralysis of the bladder exists, a large quantity of retained urine may be drawn off, while, if there is a stone in the bladder, the operator will often be able to form a shrewd suspicion of its presence by experiencing a grating sensation as the catheter leaves the bladder; and the probability of its presence will be much increased if there is a stain of blood at the meatus as the catheter comes away, and especially if the patient at that moment complains of pain.

Rectal Examination.—The introduction of the finger into the rectum will enable the surgeon to detect, at once, any abnormal

condition of the prostate. He will note the size of the organ, and, should it be enlarged, will determine the nature of the swelling. If the gland is acutely inflamed, it will be hot and exquisitely tender, and if abscess has formed, fluctuation will be sufficiently obvious. The finger in this position may also gather useful information as to the condition of the bladder; if that organ is full of habitually retained urine and no catheter has been passed, the distension will be readily felt. Any organic deposit in the wall of the bladder at its base will be also distinguished. During a rectal examination the vesiculæ seminales should always be defined; they are very likely to be enlarged from tubercular deposit if any other portion of the urinary tract is so affected. In boys, a vesical calculus is often easily felt by the finger in the rectum. Suprapubic pressure will aid a rectal examination.

Stone not infrequently exists in addition to one or more of all those complaints for which its symptoms may be mistaken, and sometimes stone is a direct consequence of certain of these diseases. *See STRICTURE OF THE URETHRA; PROSTATIC HYPERTROPHY.* But if a well-marked stricture is found, or an enlarged prostate, or atony, or paralysis of the bladder, the patient should be subjected to appropriate treatment, and sounding must be delayed, unless the symptoms of stone are very marked, in order to avoid aggravating these affections by instrumental disturbance. If treatment fails to relieve the symptoms, the case must be further investigated and the bladder sounded.

SOUNDING FOR STONE.—The operation consists in the surgeon introducing a metal rod into the bladder, and searching with it for the stone. He is not satisfied that a stone is there unless he feels it with the sound, and hears the characteristic ‘click’ made by the contact of his instrument. Sounding must never be hastily or lightly undertaken, for there are many instances on record of its having been followed by fatal results even in children, although they are much less susceptible to such interference than men. Sounding is, therefore, an operation which must be performed with every precaution and with extreme gentleness.

The sound consists of a cylinder of polished steel or of silver, about nine inches long, and in size equal to No. 7 of the English catheter scale. The final inch is curved at an angle of 120° to the shaft, forming a beak with its extremity smoothly rounded. The other end is fitted with a

handle, preferably cylindrical. A child’s sound is of the same shape, but of course much smaller. A couple of sounds, one equal to No. 1 and one to No. 3, will suffice for all cases of children. A sound is quite unlike a metal catheter, with which it has nothing in common. No patient should be sounded with a metal catheter or catheter-shaped sound.

Simple as the operation of sounding may appear to the inexperienced, there is no minor operation in surgery more important, or requiring more delicacy, skill, and experience, for the possibilities of error are numerous.

Sounding a Child.—An anæsthetic should always be administered if possible. A sound of appropriate size is selected and used with gentleness. The mistake most likely to occur is that of not finding a stone when it is really there; the opposite mistake is not of common occurrence in the child’s bladder, although contact of the sound with the bony prominence of the ischial spine has been taken to be contact with a stone.

Sounding a Man.—A patient should rarely be sounded unless he is prepared to rest quietly in a warm room for twenty-four hours afterwards. A railway journey, for example, taken immediately after being sounded, has not infrequently been followed by alarming illness (urinary fever), and sometimes by death. A minor accident after sounding is an attack of retention of urine, for which the surgeon must be prepared. An anæsthetic is rarely necessary. The surgeon should so plan his examination that there is not more than an ounce or two of urine in the bladder, or he may empty the bladder by means of a soft catheter, and inject an ounce of tepid water into the organ. The patient lies on his back upon a couch, with the head on a low pillow, the buttocks raised upon a pillow higher than that under the head, the knees flexed, the soles of the feet on the couch, and the thighs rotated outwards. The surgeon frees his own wrist from any jingling jewellery and, standing on the patient’s right side, introduces the sound, which has been made absolutely clean, and has been lubricated with a little carbolised oil. As the beak of the sound enters the prostatic urethra, the instrument is gently rotated from side to side upon its long axis, in order that the beak may be lateralised right and left directly it enters the neck of the bladder, for it is here that most stones are found. Having searched the sides of the bladder and the upper fundus, the handle of

the sound should be depressed so as to raise the beak in the bladder; the beak should then be turned downwards and brought forwards to the neck of the bladder, sweeping the floor from side to side. In this way many a stone, which otherwise would have escaped detection, will be found lying behind and below the enlarged middle lobe of the prostate. All these movements should be slow; the too eager operator, by his energetic movements produces currents in the urine, which move a small stone about in such a way that it eludes the sound.

Contact with the stone having been obtained, it is very desirable to form an opinion as to its nature, size, and also whether there is more than one stone present. It is not unusual for an experienced hand to fall into error concerning these particulars. The sound of the instrument striking the stone is characteristic of the three chief kinds of calculus: the sound of an oxalate calculus is like that of a piece of iron; a uric acid stone sounds like a piece of marble, and a phosphatic calculus sounds and feels like a piece of mortar. By passing the sound to the extremity of the stone, and then tapping as the instrument is withdrawn, a very fair idea of the size of the calculus may be formed. The sound may be the means of forming an opinion as to whether there is more than one stone; but the certain method is to introduce a lithotrite, seize the stone, hold it tightly in the lithotrite, and use it and the instrument as a sound in searching for more stones. The larger the stone the fuller the ring of the sound upon it. Small stones of all kinds produce only a tinkling sound; when they are very small the sound is a mere tick. It is difficult to mistake an acid stone when once the sound has touched it, but the phosphatic calculus is not infrequently passed over as a mere sabulous condition of the mucous membrane.

The sources of error in sounding will now be discussed. There are few mistakes in surgery more annoying than to miss a stone, although it is an accident which may occur to the best surgeon. (Cheselden, the distinguished lithotomist, missed a stone in a case which is historical.) There are also few mistakes more terrible than to find a stone when in reality none exists. We will first consider how a stone may be missed, putting aside, of course, the possibility of a careless or clumsy hand, or a dull ear.

SOURCES OF ERROR IN SOUNDING. — I. *How a Stone is missed.*—1. The sound may not have passed into the bladder. A capacious prostatic urethra, or a prostate

hollowed by disease, may deceive the surgeon, and the actual cavity of the bladder may escape without examination.

2. A common mistake is to have too much urine in the bladder. A small stone in eight or ten ounces of urine is frequently difficult to catch.

3. Too much movement of the sound produces currents in the fluid contents of the bladder, which move the stone away from the instrument.

4. The sound is frequently allowed to pass the neck of the bladder without any rotation upon its long axis, so that the beak glides by and does not strike a stone lying close to the neck, the movements of the sound being confined to the superior fundus, where the stone is not likely to be. Of all mistakes, the writer believes this one to be the commonest.

5. The hypertrophied prostate may project like a hen's egg into the cavity of the bladder. There is of necessity below this projection a deep and narrow sulcus, in which a stone may lodge and defy detection by any ordinary examination. To find a stone so placed, the beak of the sound must be reversed directly it has entered the bladder, and the handle of the sound raised as much as possible. The forefinger passed into the rectum may facilitate the search.

6. A stone may have lodged in a sacculus or have become engaged between the fasciculi of an hypertrophied bladder, or it may be arrested at the opening of the ureter into the bladder, or may have become so covered by mucous membrane that a sound cannot easily reach it.

In the last case, it is perhaps generally more correct to say that the stone has been formed in a sacculus, which has only a minute aperture of communication with the bladder, so that for all practical purposes the calculus is covered by mucous membrane. Sacculated or semi-sacculated stones may therefore escape detection, until felt by the finger introduced by means of a perineal incision.

II. *How a non-existent Stone may apparently be found.*—1. Noises are produced by the patient's or surgeon's clothes and appendages, which may deceive the unwary; for instance, the ticking of a watch, the tinkling of jewellery, especially the surgeon's sleeve-links, the creaking of a boot, or the chink of money.

2. A well-oiled sound will often produce in the urethra a sucking noise, not unlike that of a small stone.

3. A vesical tumour may become covered with phosphates, and, especially if

pedunculated, will give a sensation very like that of a stone. In cases of real doubt the lithotrite will clear up the mystery.

4. A growth from the middle lobe of the prostate may practically form a vesical tumour, as under the last heading, and become coated with phosphates.

5. Vesical rugæ, if old and hard, may appear very like calculus; the sound may even elicit a dull note on striking them.

6. Phosphatic deposit may occur upon any portion of the vesical mucous membrane which is unhealthy.

7. Certain bony parts in the neighbourhood of the bladder, as, for example, the sacral promontory and the ischial spines, have, especially in the child, been mistaken for stone.

8. The bladder itself may beat upon the end of the sound, exactly as a bird's wing might be supposed to beat. This has been called 'the fluttering stroke of the bladder,' and is a well-recognised phenomenon. It can only deceive those who are unpractised in bladder-manipulations.

Many contrivances have been planned for intensifying the sound produced by the contact of an exploring sound with a vesical calculus. The microphone, sounding boards, and the lithophone, may be cited as examples. The lithophone consists simply of a rubber tube fixed into the operator's ear and attached at the other end to the sound; some may find such an instrument of assistance, but in reality a simple sound is the only instrument required in addition to a practised and sensitive hand and ear.

A stone having been found, the only question is which operation—lithotrity or lithotomy—shall be performed for its removal. All attempts at solution by medicines taken by the mouth or injections made into the bladder are useless, and generally worse than useless.

CHOICE OF OPERATION.—Lithotrity or lithotomy?

In the Boy.—Up to the present time, boys suffering from vesical calculus, with very few exceptions, have been always subjected to lithotomy, and with excellent results. Lithotrity has not been considered a suitable operation, owing to the unfitness of the child's bladder for the residence of fragments of stone, and the urethra for the expulsion of sharp-edged pieces. Now, however, that lithotrity at one sitting—by which is meant the crushing and complete evacuation of the calculus at a single operation—is accepted as yielding in the adult far better results than the older or many-sitting method, it is not unlikely that the

single-sitting operation may prove superior even to lithotomy in children; for, if efficiently carried out, lithotrity will no longer be open to the objections formerly urged against it. In this country, we have not at present evidence upon which to found a definite opinion upon the question; but, in India, lithotrity at one sitting has been performed with marked success upon a number of children. The surgeon may therefore choose for himself between lithotomy and lithotrity, if called upon to operate upon a boy; but, if inexperienced in lithotrity, he will perhaps do well to decide in favour of the former. See LITHOTOMY.

In the Man.—Here lithotrity is the rule, and lithotomy is becoming yearly more and more the exception. Lithotrity has always, *cæteris paribus*, been the safer proceeding, and now that the operation at a single sitting, with complete evacuation, has fully justified its claims to superiority over the older or many-sitting method, lithotrity for all practical purposes may be considered incomparably safer than lithotomy, and with rare exceptions it can always be performed. See LITHOTRITY.

There are four conditions in which lithotrity is contra-indicated: (1) *When the urethra is deformed*, owing to cicatrization after abscess from stricture, or mechanical injury, or even old hip-joint disease. In such cases, the urethra is often bound down by old adhesions, and is irregular from the existence of urinary fistulæ. A staff can be introduced after suitable attention and even operation, and lithotomy performed, but lithotrity will be impracticable unless the stone is very small (under an inch in diameter). Ordinary stricture of the urethra is no hindrance to lithotrity in experienced hands. An internal urethrotomy may be performed, or the stricture can be dilated. The writer's plan yields good results. He dilates the stricture while the patient is under the influence of ether, by passing in immediate succession a series of highly polished conical steel dilators, up to 16 (Eng.) Lithotrity is then performed, and the necessary instruments pass without special difficulty, which is not always the case if an incision has been made into the urethra, as in internal urethrotomy.

(2) *When the stone is very large.*—All stones may be said, in general terms, to be mechanically crushable; but the injury inflicted upon the bladder in crushing a uric acid stone of, say, three ounces in weight or two and a quarter inches in diameter, or a phosphatic stone a little larger, will be so

great that it will nearly always be safer to perform lithotomy.

(3) *When the stone is very hard.*—An oxalate stone of over an ounce in weight, or even a very large round uric acid calculus, may prove uncrushable by any ordinary lithotrite, and an instrument sufficiently powerful to break them will be so injurious to the urethra and bladder, that lithotrity must be set aside in favour of lithotomy.

(4) *When the nucleus of the stone consists of a foreign body incapable of being crushed.*—If the history of the case be distinct, lithotomy must be the operation selected.

Prostatic hypertrophy, atony and paralysis of the bladder do not interfere with the proper performance of lithotrity.

When lithotrity has been attempted and abandoned on account of one or more of the four contra-indications, the patient's chances of recovery will be much enhanced if lithotomy be performed at once. The case must necessarily be a severe one, and the mechanical interference with the urinary organs may cause such constitutional disturbance from urinary fever and cystitis, that the patient may die in a few days, without giving the surgeon another opportunity of operating, or at any rate a serious illness may cause considerable delay. It is therefore wise, whenever unusual difficulty is expected in the operation of lithotrity, to make preparation for, and obtain the patient's consent to the immediate performance of lithotomy, should lithotrity prove impossible. If lithotomy has to be performed, the selection of the method of cutting for the stone must very much depend upon the particular operator. The median method can only be required now for the removal of foreign bodies from the bladder, or in cases where the stone is not large, and lithotrity is only put aside on account of urethral deformity with perineal cicatrisation, the consequences of old-standing neglected urethral stricture. In cases of large stones, the choice is between lateral and suprapubic lithotomy. Dr. Petersen's method of distending the rectum with an air-bag and so pushing up the bladder, has rendered suprapubic lithotomy easy of performance, and apparently well adapted for the removal of large calculi; but further experience is required of this operation before a decided opinion can be given, and a comparison made between it and lateral lithotomy. See LITHOTOMY.

Is a patient with stone in his bladder to be left unrelieved by operation under any circumstances? A patient known to have

stone, but suffering little or no inconvenience from it, should never be advised or allowed to postpone operation beyond a very short period (a few weeks), because he can certainly never be in better health for operative procedure, and the stone, if retained, must gradually grow larger, and the operation for its removal become proportionally more formidable. There are, however, graver cases, where the patient is so worn by his sufferings, or by the presence of other disease, that the surgeon may well hesitate before subjecting him to an operation for stone. Are there *any* cases which should be left unrelieved by operation? This is a question which not infrequently has to be answered under circumstances of great anxiety, and the writer fully realises his responsibility in making the following remarks. From an extensive experience of many grave cases of stone in the bladder, he has no hesitation in saying that a patient with a stone in his bladder should almost invariably submit to an operation for its removal, however old or ill he may be. It is certain that if the stone is left it will destroy him, and not only that, but probably in the most agonizing manner. Death from stone in the bladder is generally preceded by prolonged torture, unless the patient is tolerant of, and susceptible to, opium, or unless uræmic coma mercifully comes to his aid. One of the exceptions to the rule here laid down must be the case where lithotrity is impossible, and the kidneys so extensively diseased that lithotomy may be expected to be immediately fatal. Cases, to all appearance most desperate, will often make astonishing recoveries if the stone is skilfully and entirely removed.

G. BUCKSTON BROWNE.

STONE IN THE URETHRA may be classified under two heads—1st, the acute; 2nd, the chronic. In the former, a calculus is passed down from the bladder, and, lodging in the urethra, causes more or less complete obstruction in the flow of urine. It may lodge anywhere in the canal, but as the meatus is the narrowest point of the passage, the most frequent site of impaction is the fossa navicularis. The penile urethra is the favourite site, from its greater proportionate length, greater amount of muscular spasm, and its numerous lacunæ. A not uncommon locality also is the membranous portion, just behind the anterior triangular ligament.

The stone is generally globular in shape, and seldom larger than a pea; but if permanent lodgment occur, with only partial

obstruction to the flow of urine, it loses its original shape and becomes elongated, resembling a date-stone; it then causes a certain amount of dilatation of the urethra, generally confined to one wall, a sacculus being formed, and thus allowing a fairly free passage for the urine. The tendency is for a stone to pass outwards towards the meatus, unless prevented by organic stricture, being in marked contrast to the opposite tendency of foreign bodies introduced into the urethra. These stones most frequently become impacted in children, on account of the small calibre of the urethra.

In the second class of cases, the symptoms are referable almost entirely to the primary complaint—stricture. Dilatation always takes place behind a stricture, and so forms a convenient receptacle for stagnant urine, which is favourable to the formation of calculous material or, what is more likely, its deposit on small stones or crystals passed from the bladder, which in a healthy urethra would have made their escape unnoticed. These cases occur almost invariably in adults, and the symptoms to which they give rise are but slight. The calculi may be of any kind found in the bladder, and when impacted they increase in size by deposit of the same material.

Symptoms of Impacted Stone.—While micturating, the patient suddenly feels intense pain; the urine which has been flowing freely as usual completely stops; violent straining ensues, which may dislodge the stone at once, especially if it come down in the first gush and there is a good head of water in the bladder to flush it through. Frequently this force is insufficient, and nothing but blood is expelled, and this is more common when the calculus is of irregular shape. The straining then passes off for a while, though great pain is complained of at the site of impaction and in the glans penis. After a while, the want to micturate is again urgent and straining re-ensues, which may force a little urine by the side of the stone if the obstruction be incomplete, and the urethra then becomes slowly accustomed to the presence of the stone; though severe pain is felt for a long time, and there is always a prospect of a complete block taking place if the stone be dislodged from its position.

Treatment.—Direct the patient to retain his water as long as possible, unless there be already complete retention; compress the glans penis between the finger and thumb, and tell him to try and micturate by straining as hard as possible; a

small round stone may be then easily dislodged, as the force of urine expands the whole passage and flushes it through. If these simple means fail, a stone in the penile urethra can generally be safely extracted by means of a fenestrated earscoop. If the stone be merely retained in the fossa navicularis by a tight meatus, this may be safely incised downwards towards the frænum. The small incision readily heals. If, however, the stone lies in the bulbous or membranous urethra, and there is little prospect of speedy removal through the meatus, a long fenestrated scoop may be applied. One form of scoop is made to bend over behind the stone by an internal screw, so as to secure a better hold, and there are endless varieties of long narrow forceps with joint and spring action, of every conceivable shape, their very number being a fair index of their inutility; these may be gently passed down the urethra, and an attempt made to grasp the stone, but great care must be used not to lacerate the mucous membrane in passing them or in seizing the stone. This little operation is most conveniently performed under anæsthetics. During this manipulation, digital pressure must be applied either in the perineum, or, if necessary, in the rectum, to prevent the stone being pushed back into the bladder. If the stone cannot be extracted, two courses are open: to push back the stone into the bladder, or to cut down upon it and extract it.

Here, the choice of the operation is determined by the age of the patient. In a child, it is best to open the perineum in the median line, the operator being guided either by feeling the stone, or by a straight staff passed down the urethra, and made to project into the perineum. A stone in the bulbous urethra can then be pushed out backwards; the bulb should not be incised, if possible, on account of hæmorrhage. In an adult, if attempts at extraction fail, the better procedure is to push the stone back into the bladder, this being best effected with a hollow-ended catheter. When the stone is fairly in the bladder, the operator can break it up at his leisure, or by slowly screwing down the lithotrite can compress it rather than break it, and so extract it practically entire.

Results of neglected Urethral Stone.—If retention be complete these are very grave. The first attempt at micturition being unsuccessful, the bladder remains for a time quiescent; but the distension soon gives rise to great pain, and repeated straining ensues, until at length the urethra is rup-

tured and the urine is forced into the surrounding cellular tissue. This for a time greatly relieves the bladder, but intense pain in the perineum soon sets in, with all the symptoms of extravasation of urine, and, unless free incisions be made at once, the constitutional disturbance and sloughing set up by the irritant action of the urine soon carry off the patient. *See* EXTRAVASATION OF URINE.

When the obstruction is slight, the stone may increase to an unlimited extent, forming for itself a pouch in the urethral wall, which gradually becomes absorbed by the irritation and inflammation set up. The stone thus gets to lie outside the urethra, and may slowly ulcerate its way out through the scrotum or perineum. This explains the curious fact that a catheter may be passed right into the bladder without feeling the stone, though it is known that a large one is present.

As an instance of the size which these stones may sometimes attain, it may be mentioned that the Norfolk and Norwich Hospital Museum contains a specimen of this class weighing eight ounces, which was removed from the scrotum. It consists of a central uric acid nucleus as large as a pea; around that some mixed urates and phosphates in an oval shape; the rest of the great mass of the stone is composed of dense white phosphates. T. W. CROSSE.

STRABISMUS.—CONVERGENT STRABISMUS (HYPERMETROPIC).—A very large majority of all cases of convergent strabismus are due to hypermetropia. The hypermetrope, in order to see clearly at any given distance, must make a greater accommodative effort than is normal for that distance; but, since accommodation and convergence always go together, this excessive effort tells also on the ciliary muscles; consequently the hypermetrope tends to converge for a nearer point than that at which he desires to look. If he cannot avoid an excess of convergence, he instinctively turns both eyes slightly towards one side or the other, so as to bring one eye to bear on the object while the other takes the whole deviation, and, as it were, squints for both. The majority of hypermetropes, however, do not squint, for the relation between corresponding degrees of accommodation and convergence is not absolute. With a given accommodative effort, it is possible to vary the angle of convergence to some extent. This does not necessarily disprove an anatomical association of the two functions; it may be, that a given effort of the centre for

convergence can be more or less neutralised by an opposing effort of the centre for divergence.

In slight degrees of hypermetropia, it is thus possible to preserve the required angle of convergence, in spite of the excess of accommodation, and there is no squint. In very high degrees also, there is usually no squint, for the strongest accommodative effort proves insufficient to bring the eye into focus, and is therefore instinctively abandoned. It is thus, in moderate degrees, that strabismus is most likely to arise. It commonly begins in childhood at the time when the eyes are first freely used on near objects; as in learning to read and write. At first the strabismus is often periodic, appearing and disappearing in accordance with the amount of accommodative effort made. After some weeks or months, it generally becomes confirmed in distant as well as in near vision. When the two eyes have equal degrees of hypermetropia and are equally sharp-sighted, the squint is likely to alternate between them according to the position of the object looked at; thus, in looking at an object to the right of the middle line the left eye will be used, while the right deviates inwards, and *vice versâ*. But, if either eye be at a disadvantage as regards the degree of the hypermetropia, the presence of astigmatism, opacity of the cornea, or any other defect, the patient will instinctively at all times fix with the better eye and squint with the worse. In a few cases, a squint remains periodic for many years, and in a few it continues for a long while to alternate, but in the large majority it becomes persistent and constant in the one eye.

Referring again to the simultaneous action of the convergent and the conjugate centres necessary to bring the one eye to bear upon the object, it will be seen that in the fixing eye the two impulses fall one on the internal, the other on the external rectus, while in the squinting eye both fall on the internal rectus. The persistent contraction of the latter leads to its permanent shortening, so that, even in the absence of all accommodative effort, parallelism of the eyes is not recovered. In the squinting eye, the picture is formed at some distance from the macula lutea—that is, at a less sensitive part of the retina than in the fixing eye—hence it is easily neglected or suppressed, and the eye becomes amblyopic from non-use. In many cases of long standing, the squinting eye loses all power of true fixation, and, even when the good eye is covered, is wrongly directed in its efforts

to look at the object. Double vision is uncommon in this form of strabismus; the absence of a faulty projection may be connected with the fact that the position of the deviating eye is not independent of and disproportionate to the impulse of the will, but is the normal result of an excessive impulse. See OCULAR MUSCLES, Affections of the.

There are a good many cases of comitant strabismus in which, though hypermetropia is probably the essential cause, the circumstances of the onset, the apparently capricious appearances and disappearances, and the variations in the amount of the deviation, demand some further explanation. Thus, a squint not infrequently begins during an attack of hooping-cough, measles, or some other childish disorder, or after a fright; it is distinctly aggravated by digestive or mental disturbance; it may even vary regularly from day to day, or at longer intervals, with remarkable periodicity. In such cases, it may be assumed that the convergent centre, always irritable and tending towards overaction by reason of the hypermetropia, is suddenly thrown into a state of spasm by other causes, or possibly that the controlling action of the opposing centre is weakened or lost. There are, moreover, cases of convergent strabismus in all respects resembling those now under consideration, except that there is no hypermetropia; these, however, form a very small minority.

Symptoms.—These have for the most part been described in the foregoing paragraph. The first step in making the clinical examination is to make sure that the squint is real and not simply apparent. In young children, the appearance of a convergent strabismus is sometimes simulated by the condition termed epicanthus, a redundant fold of skin between the eye and the nose, which overhangs the inner canthus and makes it appear that the cornea is too near to it. The appearance is at once removed by pinching up the skin at the root of the nose between the finger and thumb. Again, in nearly all eyes the axis of the cornea forms an angle with the axis of vision, or, in other words, the point at which the eye actually looks lies not exactly in a line with the anatomical axis of the globe, but a little to its inner side. In the normal eye the angle amounts to about 5° ; if it be much less than this, as it often is in myopia, we have an apparent convergent strabismus, while if it be greater, as in some hypermetropic eyes, a divergent strabismus is simulated.

The presence of an actual deviation is easily proved. The patient being told to look at a distant object, we hold a hand or a card over each eye in turn; if either eye moves when the other is covered, in order to look full at the object, we know that it was previously directed wrongly; we thus learn which eye habitually fixes and which deviates. If no deviation manifests itself while both eyes are open, we note whether either eye deviates behind the hand covering it; and supposing no deviation to be discoverable, under any circumstances, in distant vision, we ascertain whether a squint is elicited by accommodation for a near point, as in reading small type held in the hand. A squint, which occurs only when the eye is excluded from participation in vision, is termed *latent*, while one which persists when both eyes are uncovered, is termed *manifest*. Each eye is then tested with regard to its ability to move freely inwards and outwards, in order to ascertain whether there is any decided limitation of movement, either through shortening of the one muscle or weakening of its antagonist.

It is well also to measure the amount of the deviation, although this is not essential for correct treatment. It may be done either by linear or by angular measurement. The good eye being fixed on a distant object straight in front of the face, the distance between the centre of its cornea and the inner canthus is measured on the lower lid by means of a small scale or strabismometer, and then, before any movement is made, a similar measurement is made in the squinting eye; the difference between the two measurements represents the amount of the deviation. A more precise, though rather more troublesome, method is to make an angular measurement with the perimeter. A distant object is placed in line with the axis of the instrument, and the arc is placed horizontally; the deviating eye is then placed in the usual way at the centre of the arc, and the patient is told to look at the distant object; this he does with the good eye. Taking a lighted candle in his hand, the observer passes it along the arc, keeping his own eye close to it, until the reflection of the flame appears in the centre of the cornea of the deviating eye; the position of the candle is then read off upon the arc. The angular distance between this point and the centre of the arc represents the angular deviation of the eye. More important than a precise measurement of the deviation is the estimation of the refraction in both eyes. With the help

of the shadow test (retinoscopy) this is very easily and quickly done, even in young children, and even though the squinting eye be highly amblyopic. If the patient is old enough, the acuity of vision should also be ascertained. The prospect of obtaining a complete cure varies in proportion as the acuity of the deviating eye is good or bad.

Treatment.—A periodic strabismus may usually be removed entirely, for the time being, by the free use of atropine to both eyes, for, so soon as the ciliary muscles are completely paralysed, accommodative efforts are abandoned, and the excessive convergence dependent on these efforts disappears; if any shortening of the internal rectus has already taken place, the atropine will not remove the deviation, though it will probably diminish it. The use of eserine may produce the same result in exactly the opposite way. By a moderate use of eserine, it is possible to increase the excitability of the ciliary muscles without keeping them in a state of spasm; so that to a given impulse they will respond more vigorously than in the normal state. With its help the hypermetrope may thus succeed in accommodating sufficiently without excessive effort, and, consequently, without excessive convergence. These remedies are, however, temporary in their effects. By some surgeons atropine is employed as a preliminary to other measures, in all cases. Eserine is less frequently used. The essential treatment of a convergent strabismus consists in the correction of the hypermetropia by glasses, and if this does not remove it, in tenotomy of one or both of the internal recti. Glasses should be given which correct the greater part of the hypermetropia discoverable by retinoscopy, which will usually be greater than the amount which is manifest on testing with types and lenses. These should be worn constantly. If the deviating eye be amblyopic from non-use, it should be used alone, while the other is covered, for a few minutes every day; by this means its acuity will probably be raised, and the prospect of restoring binocular vision greatly improved. At the end of from one to three months, the benefit obtainable by optical means will usually be manifest, and, if the strabismus persist, the case must be treated by tenotomy. Children should not, as a rule, be operated on until they are old enough to wear glasses—i.e. until about six years of age. If a strabismus appear much earlier than this, it may be combated for a while with atropine, and the acuity of the squinting eye may be kept intact by covering the other

with a shade or a bandage for a certain time each day.

Tenotomy of the Internal Rectus.

The tendon of the internal rectus is attached to the sclera at about 5 mm. from the corneal margin, and more loosely by connective tissue to the conjunctiva and to Tenon's capsule—the fibrous envelope which surrounds the globe and separates it from the other contents of the orbit. The operation of tenotomy consists in completely dividing the tendon close to the sclera, and separating it more or less from its other attachments; these latter prevent it from withdrawing itself completely from the globe, and retain it in a more or less retracted position, where it forms a fresh and firm adhesion with the sclera. The aim of the operation is to set back the insertion of the tendon sufficiently to neutralise the effect of its previous shortening, without abolishing its ability to rotate the eye inwards to the normal extent. When the deviation exceeds 5 mm. in extent—that is to say, in the majority of cases which come under notice—it is better to operate on both eyes, setting back the tendon to a moderate distance in each, than to attempt to obtain the whole correction in the one; symmetry of the attachments in the two eyes is thus retained, and the danger of displacing the one tendon to such an extent as to impair its efficiency is avoided. The connective-tissue attachments of the tendon should, however, be divided more freely in the eye which habitually squints than in its fellow, so that the effect may be greater on this side than on the other. An over-effect is guarded against most certainly by operating on one eye only at one time; but, in very many cases, an experienced operator may with confidence divide both inner recti at one time, especially if he adopt the subconjunctival method recommended below.

An anæsthetic—chloroform or ether—has, until lately, always been found necessary in children; in older subjects, with ordinary self-control, it may be dispensed with. Since the introduction of cocaine as a local anæsthetic, the practice in this, as in many other ophthalmic operations, is changed. Two or three applications of a two or a four per cent. solution, at intervals of two or three minutes, produce insensibility in the conjunctiva, and a few minims of the solution may then be injected beneath the conjunctiva, by means of a hypodermic syringe without causing pain. The whole of the operation is thus rendered almost, if not absolutely, painless. A

special advantage of this method is that the amount of effect produced by the tenotomy in the one eye can be better estimated at once, before the other eye is dealt with, than when the patient is under the influence of a general anæsthetic. The instruments required are the speculum, the fixing-forceps, a strabismus hook, one which is flattened sideways and not bulbous at the extremity being in the writer's opinion the most convenient, and a pair of blunt-pointed straight scissors; curved scissors are used by some operators, but have no evident advantage, and in unpractised hands are likely to be passed too far backwards along the surface of the sclera, a mistake which is followed by copious bleeding into the orbit and protrusion of the globe; a needle threaded with silk or gut is sometimes required as well.

The patient is placed in the recumbent position; the surgeon stands at the patient's right hand, in which position he is conveniently placed for operating on both eyes. He separates the lids widely with the speculum; with the fixing-forceps, held in the left hand, he seizes the conjunctiva below the insertion of the internal rectus—i.e. about midway between the canthus and the corneal margin, but an eighth of an inch or more below the horizontal meridian of the globe. With the scissors, in the right hand, he snips through the conjunctiva, and then, if it be not divided at the same time, picks up the subconjunctival fascia and divides that in like manner, the aperture being large enough easily to admit the scissors with closed blades, but not larger. The blades may then be introduced into the wound, and widely opened beneath the conjunctiva so as to stretch without cutting its connections with the outer surface of the tendon; or, if a considerable correction has to be effected, these attachments may be divided by a few snips towards the canthus, care being taken to keep the points well forwards beneath the conjunctiva, and not to cut deeply backwards along the curvature of the globe.

The scissors are then laid down, and while the forceps in the left hand still hold the conjunctiva close to the wound, the hook is taken in the right hand, and with its concavity turned away from the operator, and its point directed backwards as though it were to be carried towards the posterior pole of the eye, is passed deeply into the wound and swept round along the surface of the globe, so that its point passes upwards between the tendon and the sclera, and projects beneath the conjunctiva above

the insertion of the tendon. If an attempt be now made to carry the hook forwards towards the cornea, it will be found to move the globe by its traction on the tendon beneath which it lies. The forceps are now laid aside and the hook is transferred to the left hand, and held parallel with the side of the nose and with some forward and outward traction upon the tendon; the scissors, held in the right hand, are passed with slightly opened blades between the hook and the eye, so that one blade passes on each side of the tendon, and then with one or two snips, the latter, which is felt as a firm resisting substance, is cut through as close to the sclera as possible. When the tendon is completely divided, the hook can be brought forward beneath the conjunctiva quite up to the margin of the cornea; it should be re-introduced in the same manner as before to make sure that the division is complete. If much blood be effused beneath the conjunctiva, a small aperture may be made with the scissors above the insertion of the tendon to favour its escape. The bleeding is likely to be more profuse when the subconjunctival fascia is freely divided with the scissors, than when it is simply stretched by widely opening the blades beneath the conjunctiva.

The after-treatment consists merely in keeping a fold of wet lint over the closed eyelids for a few hours, and avoiding exposure to wind, bright light, and other possible sources of irritation during the next few days. A little finely powdered iodoform, dusted upon the conjunctiva in the neighbourhood of the wound, is a good safeguard against septic inflammation of the tissues, a complication which is occasionally met with in badly nourished subjects, and which, in very rare instances, has been known to lead to orbital cellulitis and loss of the eye. The discoloration due to the extravasated blood, which may extend to the eyelids, usually disappears in from two to five weeks.

Disasters during the operation are seldom met with; if sharp-pointed scissors be used, or if the blades be introduced with much force, it is possible, however, to wound the tunics of the eye. If the globe is pushed forwards by a deep outpouring of blood into the orbit before the tendon is divided, cold compresses and a roller bandage should at once be applied, and the tenotomy postponed. If the immediate effect of the operation is manifestly insufficient, it may be increased by a further division of the subconjunctival tissue or by passing a silk suture underneath the conjunctiva, near to the external margin of the

cornea, so as to include about 6 mm. of it, and fastening the two ends to the skin of the temple with strapping, so as to draw the eye into a position of strong outward deviation; or the suture may be introduced close to the external margin of the cornea, and carried underneath the conjunctiva to the external canthus, and then tied over, so as to gather the conjunctiva into a fold which draws the eye outwards. The suture should remain for a day or two. Should the immediate effect be obviously too great, it may be diminished by a similar conjunctival suture at the inner side of the eye, or later, if it should prove necessary, by division of the external recti or advancement of the inner, one or both, or by a combination of these measures. The immediate effect should be that the eye cannot be turned so far inwards as before, the tendon now acting only through its connective-tissue attachments; during the following week the effect diminishes as the tendon forms a fresh and firm adhesion with the sclera; ultimately it again somewhat increases as the uniting tissue becomes stretched by use.

A simple subconjunctival tenotomy, with little cutting of the subconjunctival fascia, usually alters the position of the eye to the extent of 3 or 4 mm. If it is found, at the close of the operation, that the patient can converge for a point about six inches from his face, and can maintain this degree of convergence steadily, a perfect result is likely to be obtained; but if either eye deviates under this test, the effect of the tenotomy is likely to prove somewhat too great or too small, as the case may be. The continued use of spectacles after the operation is generally desirable, both as a safeguard against a return of the strabismus, and for the sake of good vision; if, however, the effect of the tenotomy tends to be too great, it is sometimes well to leave a part or the whole of the hypermetropia uncorrected, so as to call more or less of the extra accommodation into play, and thereby to increase the convergent effort. Several slightly different methods of performing tenotomy for strabismus are in use. The chief variation from the method described above consists in making the aperture directly over the insertion of the tendon instead of below it. By this proceeding the tendon is exposed to view as it lies upon the hook, and the principle of dividing it subconjunctivally is abandoned.

Tenotomy of the External Rectus is sometimes required to neutralise the effect

of an excessive operation on its antagonist; it may conveniently be referred to here, although it does not usually form part of the treatment of convergent strabismus. The steps of the operation are essentially the same as those of the operation just described, but, it is to be noted that the insertion of the tendon is about 2 mm. further from the margin of the cornea than that of the internal rectus.

Advancement or Readjustment of the Internal Rectus is practised for the removal of the divergence which occasionally results from a too free division of the muscle in the treatment of convergent strabismus, and for divergence due to paralysis and other causes. It is a less simple and more painful operation than that of tenotomy. It consists in dividing the tendon at its point of attachment to the globe, and drawing it forward and detaining it in an advanced position, by means of sutures passing through it and the conjunctiva, until it forms a fresh attachment. The advancement of a tendon is usually combined with division of its antagonist, but this latter step is not always required, and may, sometimes, with advantage be postponed until the permanent result of the advancement can be estimated. The operation is performed in several slightly different ways. The following gives good results and is perhaps the simplest. In addition to the instruments used in an ordinary tenotomy, a silk or fine gut suture threaded into three curved needles is required; one needle is drawn along to the middle point of the thread, the others are placed at each end.

A vertical incision is made through the conjunctiva corresponding with the insertion of the tendon to be advanced, but not more than an eighth of an inch from the corneal margin. Its lip, together with the subconjunctival fascia, is dissected back a little way towards the canthus so as to expose the insertion of the tendon, but a separation of the conjunctiva from the tendon is, as far as possible, avoided. The tendon is divided on the hook in the usual way. One blade of the forceps is passed into the wound, and the divided tendon is firmly seized, together with the conjunctiva and fascia lying over it. The middle needle is then passed through these structures from within outwards, so as to pass as nearly as possible through the middle of the tendon behind the forceps, and the other two needles are, in like manner, passed beneath the conjunctiva in the opposite direction and brought out near to

the corneal margin above and below, at or even beyond the middle line. The middle needle being cut off, the two sutures thus formed are tied above and below, so as to draw the tendon forwards towards the corneal margin, and throw the included conjunctiva into folds. The further back in the tendon the sutures lie, the greater is the effect which can be attained. The immediate effect should be considerably greater than the permanent effect desired. Some pain is complained of during the first twelve hours, and there is sometimes a good deal of swelling of the lids, the patient should therefore be kept in bed a day or two, with cold compresses over the closed eyelids; and, as a safeguard against suppuration, a little finely powdered iodoform should be dusted on the conjunctiva twice daily. The sutures may be removed on the third or fourth day, or, if gut is used, may be left much longer without danger of their causing irritation.

DIVERGENT STRABISMUS (MYOPIC).—In a large proportion of cases myopia underlies this condition, just as hypermetropia underlies the convergent form, and to a certain extent the one condition is pathologically the counterpart of the other. In looking at an object at any given distance, the myope needs to make a smaller accommodative effort than the normal-sighted person, and, if the object be at or beyond his farthest point of distinct vision, he sees best by avoiding accommodative effort altogether; but since accommodation is closely associated with convergence, he will at the same time be apt to make an insufficient effort of convergence—that is to say, one eye will be likely to deviate outwards, while the other is directed to the desired point. A *latent insufficiency of convergence*—that is, an insufficiency appearing only when one eye is covered—is common in all degrees of myopia, while a *manifest divergent strabismus* is met with chiefly in association with the higher degrees. The former may be accounted for almost entirely by the abnormal relations between accommodation and convergence; the latter is traceable to another cause as well. The elongated form of the highly myopic eye offers an obstacle to its rotation in any direction, while the very fact of the myopia obliges the patient to bring objects very near to his eyes, and, if he is to enjoy binocular vision, to maintain an excessive degree of convergence. The double difficulty is insurmountable. Binocular vision is abandoned in looking at very near objects, and,

as a recompense for its loss, the patient is freed from the necessity of any convergent effort and from any associated accommodative action, which would of course only increase his difficulties. Any other imperfections of the eyes, which add to the difficulties of binocular vision or render it of little value, such as difference in the refraction of the two eyes, astigmatism, corneal opacities, or retinal changes, promote the deviation of the less useful eye. When once such a deviation in near vision has begun, it is likely to pass into a divergent strabismus for all distances.

Although myopia is, for the reasons stated, the commonest cause of this form of strabismus, any condition which renders the combined action of accommodation and convergence unnecessary, may lead to it; thus, an eye which from any cause has been long out of use, is liable to assume a position of outward deviation, especially if by reason of myopia, defective sight, or loss of accommodative power in the other eye, no habitual accommodative efforts are made. The slighter forms of latent divergent strabismus are frequently described under the name *insufficiency of the internal recti*; but there is no reason to suppose that the muscles are essentially defective in these cases, any more than in other forms of concomitant strabismus, and, indeed, these same muscles show no deficiency of power in conjugate movements; it is the impulse which is insufficient, either absolutely or relatively to the resistance to be overcome. Such insufficiency is induced artificially, when the accommodative effort habitually required for a given distance is diminished by optical means; thus, if a normal-sighted person attempt to read with convex glasses, he will find difficulty in maintaining the necessary degree of convergence, and if a myope, who habitually reads with concave glasses, tries to read without them, he will do the same.

In certain cases of high myopia, while there is an inability to converge sufficiently for very near objects, the eyes remain too convergent in distant vision, the abnormal form of the eye limiting its excursions in all directions.

The *diagnosis* of divergent strabismus is usually made with certainty by the tests already described; in the slighter latent forms it is made with greater precision by means of a prism. Both eyes being fixed upon an object, such as a flame in testing distant vision, or a vertical line on a sheet of paper in testing near vision, a prism of 8° or

10° is held base downwards before one eye. The image belonging to this eye appears to the patient to be displaced upwards, and fusion of the two under these circumstances is impossible. The eyes at once assume the particular degree of divergence or convergence which is most easy in connection with the given effort of accommodation; if the convergence be normal for the distance in question, the eye will remain stationary, and the two images will remain vertically placed the one above the other; if it be insufficient, the eye will move outwards and its corresponding image, the upper one, will appear to move in the opposite direction. The slightest deviation of the eye is thus revealed by the deviation of the image; it must be noted, however, that slight deviations obtained in this manner are often devoid of all practical importance. Subjectively, a latent divergent strabismus may cause much difficulty and pain in reading or other use of the eyes on near objects.

Treatment.—The insufficiency of convergent effort in near vision, which often accompanies the slighter degrees of myopia, may be remedied by giving concave glasses which correct a part or even the whole of the myopia, and thus induce a normal accommodative effort; in higher degrees, it may be neutralised by decentring the glasses—i.e. by setting them so that their centres are farther apart than the centres of the pupils, and thus giving them a prismatic effect, or by prescribing prisms for near work. *See Myopia, under REFRACTION, Errors of.* But it is to be remembered that, in high degrees of myopia, a divergent strabismus in near vision is to some extent a preservative change, tending, by abolition of the convergent strain, to save the eye from increase of structural mischief. The operative treatment of divergent strabismus consists in diminishing the effect of the external rectus by tenotomy, and sometimes by advancing the internal rectus in the manner already described. An operation cannot safely be undertaken unless the eyes are actually divergent, or unless they are found to be able to diverge to an extent sufficient to neutralise the effect of a prism of at least 10° held, base inwards, before one eye.

PRIESTLEY SMITH.

STRANGURY.—A frequent, almost constant, and irrepressible desire to void urine, which is expelled in drops by acutely painful, spasmodic contraction of the bladder and perineal muscles.

Strangury is a symptom, not a disease, and may be called forth by irritating or inflammatory affections of any part of the urinary tract. In the kidney, frequent causes of strangury are nephritis and intense renal congestion, such as follows in some persons the absorption of turpentine or of essential oils allied to turpentine, or of cantharides. Another cause is some morbid condition of the calyces of the kidney, such as the presence of calculus, tubercle, or cancer. In the ureter, the passage of a calculus from the kidney to the bladder will excite severe strangury. Of the bladder, cystitis, stone, or tumour are very constant exciters of strangury. Of the prostate, acute congestion, especially in old men, when there is hypertrophy, is a very frequent source of strangury. The affections of the urethra which are apt to cause strangury are urethritis, especially gouty inflammation of the deeper portion, or gonorrhœal inflammation of the mucous membrane of the neck of the bladder, stricture, or lastly, preternatural narrowness of the meatus urinarius.

The course and terminations of strangury are those of the disease which excites it in great measure; but it is essentially a spasmodic affection, and therefore has intervals of quiet between the acutely painful attacks. Aggravation in severity of attacks of strangury is greatly promoted by locomotion, by exposure of the surface of the body to cold, by food generally, and especially by stimulants of all kinds.

The *treatment* of strangury consists in the removal of the cause, the cure of the disease exciting the irritation, or, if that be impossible, the soothing of its effects. To those persons who suffer strangury from cantharides, other vesicants should be applied, and turpentine, copaiba, or sandalwood oil be withheld from those in whom those drugs produce renal congestion. When the cause depends on inflammation of the kidney or bladder or urethra, rest in bed, warm hip-baths, leeches, and hot fomentations are useful. Internally, free saline purging and the administration of belladonna, combined with opium or not, are the main resources. It is customary to direct bland liquids such as barley water, effervescing waters, milk, &c., to be taken freely during the attack. The writer believes that thirst may be slaked by small quantities of iced drinks; the spasm is more quickly allayed when the secretion of urine is not encouraged by the imbibition of large quantities of watery fluid.

BERKELEY HILL.

STRIÆ et MACULÆ ATROPHICÆ.

Definition.—White scar-like streaks and spots on the skin, slightly depressed below the surface.

Etiology.—Both striæ and maculæ are seen in both sexes at all ages, and may be idiopathic or symptomatic. The idiopathic striæ are most frequent in adults, and much more frequent among women who have never had children than among men, and they are more frequent in tall than short men. They are supposed, in these cases, to be due to stretching of the skin during the expansion of the pelvis and growth of the limbs. Symptomatic striæ, more generally known as lineæ albicantes, are seen most frequently after pregnancy, and are due to stretching of the subcutaneous tissue by distension; they occur from any cause of similar distension, such as ascites, ovarian or other tumours, and even accumulation of fat if rapidly developed, and in the breasts from lactation. No satisfactory explanation of idiopathic maculæ can be offered, but a similar kind of lesion, though usually classed as scars, occurs from external pressure such as results from corns, favus crusts, &c.; and the depressions remaining after absorption of inflammatory or other infiltrations of the corium, such as result from syphilis, lupus, leprosy, lichen ruber, planus, &c., are of a similar nature.

Symptoms.—The idiopathic form occurs as streaks or spots; the streaks are from one to several inches long, and a quarter of an inch or more wide, lying in parallel lines at various angles to the long axis of the body, and are situated chiefly about the buttocks, the anterior border of the ilium, the trochanters and thighs, rarely on the trunk, neck, and arms. They are pearly or bluish-white, scar-like, irregular lines, slightly depressed below the surface of the skin, which is evidently thinned in the shallow sulci. The lineæ albicantes of pregnancy, &c., before alluded to, present ultimately the same physical characters as the so-called idiopathic striæ, but at first are bluish-red from hæmorrhage, and very itchy. Striæ tend to become less conspicuous ultimately, from their edges being drawn together by the natural elasticity of the skin, but they never go away entirely.

Maculæ or spots are less common than striæ; they vary from a large pin's head to half a crown in size, are white, slightly depressed, and are seen mostly on the trunk and neck; and there is reason to believe that they are only the sequel to a more acute condition. Liveing observed a case where the spots were in all stages: in the

first, the spots were slightly red, raised above the surface, hard and fibrous; the characteristically white, sunken spots soon followed on the site of the raised spots; and finally the skin contracted, and the healthy tissues were drawn together and the spots nearly obliterated. Other observers mention antecedent hyperæmia as occurring in some cases, and, as they give rise to no inconvenience, probably the early stage is usually overlooked.

H. RADCLIFFE CROCKER.

STRICTURE OF THE URETHRA:

loss of the natural distensibility of this canal over a limited area, whereby the passage is narrowed at that part.

When at rest, the walls of the urethra are drawn closely together by its elastic and muscular contractility. They so remain until separated by a stream of urine or by a sound; further, as the flow of urine or sound pass outwards, the walls close again immediately behind them. This statement, though true for the greater part of the canal, is not quite so for the prostatic-membranous portion; the complete evacuation of this part is achieved by certain muscles which are under voluntary control. The elastic tension of the urethra will yield readily before a sound of greater size than that to which the passage is ever expanded by the flow of urine, and the width of the urethra consequently depends, within certain limits, on the amount of distending force applied. Hence, the ordinary size of the urethra means the width to which the closed tube must be dilated, to give the urine an unimpeded escape when driven from the bladder. During the flow of urine, the contractile and elastic fibres maintain a tonic pressure on the stream, to ensure its forcible ejection from the body.

The natural expansibility of the urethra differs in different parts of its length; in the prostatic and membranous portions it is greatest, having there a diameter of at least 18–20 millimètres (about three-quarters of an inch), sometimes more; and thus it allows of the passage of a man's forefinger as far as the neck of the bladder. It may be mentioned that in speaking of the sizes of urethral instruments, the French scale, where the numbers advance by 1 millimètre added to the circumference, is always followed by the writer. As the urethra passes through the triangular ligament, it is often narrower than elsewhere, except at the meatus urinarius. At the bulbous portion it widens again considerably for about two inches of its

length, and then contracts slightly during the last three inches to the meatus, which is commonly the narrowest point of all. As the penis varies in circumference in different persons, so does the urethra in dilatability; the extremes of the latter being between about 20 millimètres and about 40 millimètres; the usual expansibility being 30 or 32 millimètres. At the meatus the expansibility varies very greatly, from a mere pinhole to 40 millimètres; the most common size being 25 millimètres, or almost exactly one inch. Otis, of New York, maintains that there is a constant relation between the circumference of the penis behind the glans and the dilatability of the urethra. Thus, an outside circumference of three inches is accompanied by a urethra of a capacity of 30 millimètres; one of three and a half inches by a urethral capacity of 34 millimètres, and so on. The writer has found this a usual condition but not an invariable one, and, consequently, places little reliance on the outside measurement when desiring to know the interior capacity.

To ascertain the expansibility of the urethra or the existence and position of unyielding parts, the following instruments are necessary:—A set of bullet-sounds, some with narrow stiff stems, some with flexible ones, carrying bullets shaped like a turkey's egg, varying in circumference at the widest part from 8 to 40 millimètres. Besides these, an Otis's urethrometer is useful, which can be enlarged from 12 millimètres (about No. 6 of the English catheter scale) to 44 millimètres. The meter is useful to measure the urethra in cases of narrow meatus, or where a thin bridle of membrane, near to the meatus, prevents the condition of the urethra behind such a constriction from being explored by a sound of greater width than that of the contracted point. But it cannot be readily introduced beyond the triangular ligament, and therefore is most useful as a gauge of the penile portion of the canal. The bullet-bougies with wire stems can be bent to suitable curves, and with a little management passed to the bladder without giving pain.

The *causes* of stricture are several, but of them, two are by far more frequent than the rest. (1) The great majority of strictures are the consequences of long-continued inflammation, with or without shallow ulceration of the mucous membrane, set up by gonorrhœa; hence gleet should never be neglected, as they are frequently the only indication of the existence of a patch of inflammation in some part of the urethra,

which is slowly changing the mucous membrane there into undilatable fibrous tissue. (2) The next most frequent cause is laceration of the urethra by kicks or blows, which heal by a contracting scar. These are most commonly situated in the perineum, but may be produced at any part of the urethra. (3) Intra-urethral chancre, always near the meatus, caustic applications, lacerations caused by a calculus or by the disintegration of tubercle, are also causes, but rare ones, of stricture by the scars they leave behind them.

Age.—Stricture may be met with at any age. When before puberty, it may be caused by the injury done by an impacted calculus, or by the development of a scar after the healing of tubercle in the urethra. A case of tubercular stricture came under the writer's notice a few years ago; in which instance the cause of the stricture was ascertained *post mortem*. But as gonorrhœa is the greatly preponderating cause of stricture, and as the most common age for that disease is eighteen to twenty years, and as, moreover, stricture generally needs three years or more for its development, the decade in which strictures usually become troublesome is between thirty and forty.

The abnormal narrowings of the urethra are classified as—(1) *inflammatory*, (2) *spasmodic*, (3) *organic*. The organic stricture is the only contraction to which the term 'stricture' is applied by some surgeons; but as the other conditions not infrequently cause impediment to the flow of urine, and a narrowing of the urethra which is very easily measured, they may also be fairly termed strictures though the contraction be only transient.

INFLAMMATORY STRICTURE is a temporary local congestion and swelling of a part of the urethra, which is generally, not always, the site of some permanent induration; in other words, a stricture of wide calibre contracted by temporary swelling.

It is usually sudden in its onset, and of short duration if appropriately treated. It is met with in persons of gouty habit of body, who indulge freely in the pleasures of the table or in venery, or who, having some permanent stricture, after exposure to damp and chill get congestion of the urethra at the strictured part. The small inconvenience of this permanent stricture is suddenly and seriously aggravated into more or less complete closure of the urethra for purposes of micturition. The leading symptom is inability to pass, or great difficulty in making, urine. To this are added dull pain in the perineum, some fever, considerable anxiety

and distress, slight redness and swelling of the meatus urinarius, with thin purulent discharge. The affection is distinguished from prostatic congestion by the absence of tenderness and swelling of that organ.

The immediate treatment consists in relieving the retention with a soft, flexible catheter, No. 8 or 14 French (4 to 7 English scale), soothing the irritation by a smart purge, followed by rest in bed and salines, with opium and belladonna in small frequent doses. In one or two days the trouble ceases, and a régime must then be adapted to exclude the causes which brought on the attack. Any small organic stricture must be widened when the inflammation has subsided. This affection is very apt to recur again and again, whenever the causes already mentioned come into operation.

SPASMODIC STRICTURE is a narrowing of the calibre of the urethra by contraction of the muscular fibres of the canal. It is always met with in the deeper portion, where the muscular bands are most numerous. It may accompany the inflammatory swelling just described. In such cases, of course, the amount of the contraction due to swelling and of that due to spasm cannot be apportioned accurately to the two causes. But spasmodic stricture is also met with without inflammation—e.g. when reflex irritation is set up in the perineal muscles by the presence of a fibrous stricture at or near the meatus. Such a contraction is easily detected by the bullet-sound behind the bulbous portion, and often causes difficulty and even pain in micturition. If the anterior fibrous stricture be enlarged, the contraction and impediment in the deeper portion at once disappear. Such a condition is often mistaken for organic stricture near the bulbous portion, if by imperfect examination of the urethra the surgeon has overlooked a small amount of stricture near the meatus, and discovers only the spasmodic contraction behind the bulb, which may let pass only No. 12 or 13 (No. 6 of the English scale). Of course such spasmodic strictures disappear at once under anæsthetics.

Spasm is very apt to increase the contraction of an irritated or inflamed organic stricture, and is readily assuaged by the remedies which have been prescribed for the treatment of inflammatory stricture, especially by sufficient widening of organic contraction, if that be present.

ORGANIC STRICTURE is due to the formation of a new product of a slowly contracting nature. This permanent contraction is often increased, as already said, by

temporary inflammatory swelling and muscular spasm.

The new material is produced in various ways. Its earliest stage is inflammatory congestion of limited areas of the mucous and submucous tissue, from which the new growth may extend deeply into the erectile spongy tissue beyond those limits. It may, on the contrary, be limited to a few short bands stretched across the urethra or surrounding it. These narrow bands are termed *bridle strictures*. They are found in the ante-scrotal portion. Besides almost exclusively originating in inflammatory patches without ulceration, the spreading fibrous tissue may begin at the roots of warts, or in the floor of healing ulcers of the mucous membrane.

The indurated areas may take the form of hard knots or projections of the mucous membrane, which divert the canal with sudden twists; or, instead of forming circumscribed masses, the induration sometimes surrounds the canal, converting it for some distance into an unyielding tube of uneven surface. Hence, the stricture may vary from a thread-like band to a gristly mass invading the whole corpus spongiosum except the glans, where it never completely replaces the erectile tissue, and it may pass beyond the perineum, rendering the whole of that region hard and leathery.

The organic stricture also varies in the position of the new product and in behaviour. First, the *localities* of strictures. Strictures are found in any part of the canal as far back as the triangular ligament; and, by slow extension backwards, the fibrous induration may spread to the membranous portion, and even to the neighbouring part of the perineum. Taking all forms of fibrous stricture together, contraction is most frequent near the meatus, in the last half-inch of the urethra. Beyond the last inch, passing towards the bladder, strictures are less and less frequently met with, until the bulbous part is reached, when they again become frequent, though less so than at the outlet of the passage. In the bulbous portion, the narrowest, thickest, and toughest strictures are more commonly found, on account of the depth to which the new formation penetrates into the erectile tissue, and the mass of it which is thus produced at this situation. But very tight and massive strictures may be developed near the meatus, without any contraction existing at the bulb.

Strictures seldom extend far into the membranous part, and probably never begin there. The prostatic portion is involved

only where very extensive injury has reached the perineum. Such cases the writer has met with in miners, whose pelves have been crushed by falls of earth or the like accidents. The pubic portion of the pelvic bones has been broken and the urethra beneath them destroyed, so that, when the wounds have healed, the perineum is transformed into a mass of cicatricial tissue, through which the urine reaches the surface by one or more fistulæ.

Strictures are more often multiple than single. There are usually two or more contractions near the meatus, with an additional one in the bulbous portion. But a solitary stricture may exist at any part of the canal.

Produced in these several forms, it may be readily understood that the *behaviour* of strictures varies greatly. Some are rigid and cannot be dilated nearly to the natural expansibility of the urethra. After giving way in some degree to the introduction of the expanding bougie, the urethra yields no more. Further attempts to pass larger instruments excite inflammatory complications in the urethra itself or in the kidney, bladder, or testicle, with more or less constitutional disturbance attending them. Other strictures yield easily to dilatation and slowly contract; such have usually scanty development and a recent origin. A third set of strictures yield easily before the dilating force, but quickly shrink back to their former narrowness (india-rubber strictures).

Besides the changes in the urethra at the situation of the strictures, others take place in consequence of the irritation or injury to which the canal is subjected by the straining efforts of the bladder and perineal muscles to expel the urine, or by the treatment employed to relieve the difficult micturition. Between the meatus and the narrowest stricture, the passage, sometimes quite healthy, is more often marked with excoriations and ulcers. Just in front of the main stricture, there are sometimes perforations of the urethra into the cellular tissue, occasionally passing into the urethra again behind the stricture or into the rectum. These are termed 'false passages.' At the stricture itself, the surface is dull and roughened, and the canal somewhat tortuous; behind it, the walls are dilated, pouched, and the pouches lined with ragged ulcerated tissue. Through such pouches also fistulæ and urinary extravasations break away, from the strain to which their weakened walls are put by the impediment in front.

In cases of long continuance, the bladder is affected with chronic catarrh. If examined *post mortem*, its mucous membrane is rigid, thickened, and of an ashy-grey colour; here and there are often patches of crimson or purple colour from irritation excited shortly before death. The capacity of the bladder is generally diminished, though in old men it is sometimes dilated. The muscular coat is thickened so as to cause marked fasciculation of the inner surface. Between these ridges, pouches or sacculi are common.

The changes in the kidneys are those of chronic over-distension, either with or without acute inflammation. The ureters and the pelves of the kidneys are widened through the obstruction of the orifices of the ureters by the swelling of the mucous membrane of the bladder and the hypertrophy of its muscular fibres, and are also tortuous or pouched. Their interiors, like that of the bladder when attacked by inflammation shortly before death, are marked by red patches, but generally the surface is dense, white in colour, here and there ulcerated; the ulcers being often covered by a sheath of thick mucus. The urine in these diseased ureters and pelves is ammoniacal and horribly fetid. The changes in the kidney consist in those caused by simple pressure of the urine dammed up in the bladder, ureters, and pelves. The organ is softened, greatly enlarged, the calyces dilated, the pyramids flattened, and the cortical substance spread in a thinner layer than in the healthy organ; the capsule is toughened. The interior may be so far expanded, in extreme cases, as to convert the pyramids into funnel-shaped pouches, the cortical substance being almost wholly atrophied. In addition to this simple expansion, the kidney is commonly altered by repeated attacks of interstitial inflammation, with or without the formation of circumscribed abscesses. *See PYELONEPHRITIS.*

The *symptoms* of organic stricture depend much on the degree to which the disease has developed. Those which usually first attract the patient's attention, are caused by considerable diminution of the calibre of the urethra.

In the early stages, when the disorder is easily managed and probably capable of complete cure, the symptoms are obscure. The most constant symptom is a scanty, muco-purulent discharge, not exceeding a small drop of whitish fluid collected at the meatus on rising from bed in the morning; or even not more than a few shreds of inspissated mucus floating in the

urine, which have been washed from the surface of the patches of chronic inflammation left by gonorrhœa long after the end of the acute stage. Gleet is seldom absent from any case of stricture, either of recent origin or of long duration. It is, of course, not confined to stricture, being present in other urethral affections.

The next symptom very often present in the early cases is a little soreness or itching in some part of the canal, felt sometimes after micturition, but also as frequently quite independently of micturition. The pain and itching are not severe, and are never put forward by the patient, however much his attention may be fixed on his gleet, as a matter of consequence. Indeed, inquiry is usually needful to learn the presence of these sensations. But, as these symptoms do not point solely to stricture, the urethra of a patient should always be examined if he has had gonorrhœa at least once, generally twice or thrice, in the last three or four years, and recollects that the discharge continued as a gleet for some time after each acute attack. Very commonly, there will be found, along the tract from the meatus to the bulb, contractions at certain places, which resist the passage of a bullet-sound three or four numbers smaller than the natural expansibility of the canal; if a smaller sound slip past these places, pain is felt by the patient, and perhaps a drop of blood is brushed from the congested or excoriated patch as the sound is withdrawn.

When the stricture has advanced so far that its narrowness obviously delays the outflow of urine, the following symptoms are usually present. In such cases, an interval of from three to eight years has generally taken place between the first gonorrhœa and the patient's application for relief.

The ordinary symptoms are several: among the most usual are diminished size and force of the stream, straining to expel the urine, and increased frequency of micturition. Of the two former symptoms many patients are quite unaware, even when they are well-marked; but, if questioned, they usually acknowledge that the habit has grown on them of passing urine once or twice during the night, between going to bed and rising in the morning. Pain in passing urine is sometimes severe in cases of narrow stricture, but there may be considerable stricture without pain; while pain is a symptom of many affections of the urethra from which stricture is absent. If pain in cases of narrow stricture is felt,

it is generally described as of a 'cutting' character. Occasionally, aching pain in the perineum, a sense of weakness and fatigue or aching in the groins, buttocks, and thighs, are complained of by stricture patients. 'Twisting' or 'forking' of the stream is often present; being caused by the irregularity of the passage, and by the contracted part preventing the impulse of the bladder from driving the urine forcibly through the meatus. But an irregular or slightly narrowed meatus will make the same alteration in the stream, when no contraction is present elsewhere. Hence, 'twisting' or 'forking' is not a very important indication of stricture. A pretty constant symptom is trickling of a few drops of urine from the urethra, after the act of micturition has ceased. Thus, the patient notices that his dress is disagreeably wetted after passing water. This imperfect clearance of the urethra is due to the impediment the stricture causes to the onward flow given to the stream by the perineal muscles, when the bladder is emptied. This symptom is often absent or not noticed by many patients.

In the history of the period between the original cause of the stricture (acute gonorrhœa or wound of the urethra) there often will be found accounts of attacks of retention of urine, complete or partial, which have been overcome by medicine or by instruments. Attacks of feverish disturbance are not infrequent in some persons. These are shown by frequent calls to pass urine; increase of the pain felt while the stream flows; shivering fits, single or repeated, and accompanied by a rise of temperature to 103° F. or higher. On the other hand, none of these symptoms may be so pressing as to attract attention, and the first intimation to the patient of any disorder in his urethra may be a sudden attack of retention of urine, brought on by a fit of debauchery, by exposure to cold, or by excessive fatigue.

The consequences of so serious a disturbance of the working of the urinary apparatus may be readily conceived. As degeneration of the secreting tissue of the kidney advances, so does the nutrition of the body become seriously impaired, and liability to inflammatory affections of a low type greatly increased, among which may be mentioned pneumonia and other consequences of Bright's disease, by which the duration of life is much shortened. Even before these serious affections arise, others less hazardous, but very harassing, attack the patient. He is beset with more

frequent calls to micturate than before, and has always trouble in voiding urine, which varies between a little twinge of pain and severe suffering; while, at any time, a trifling accident may cause swelling of the stricture and jeopardy to the patient's life. If the urethra do not give way behind the stricture, and thus cause urinary abscess, extravasation, or fistula, other less active affections may develop when the kidneys have become greatly deteriorated by long interference with their function, such as cystitis or urethral fever.

The *diagnosis* of stricture, when the condition is advanced, is rendered highly probable by the diminished stream, by its altered shape, by pain or effort in voiding urine, by the trickling away of a few drops of urine after the patient has buttoned up, and by the history of previous attacks of retention. In such plainly marked cases, the question is not then of the existence of a stricture, but of the amount and situation of the contraction.

In cases where the stricture has had only a short duration, and where one slight contraction has taken place, the symptoms being limited to a gleet and occasional itching, the diagnosis cannot be made without exploration of the passage with instruments.

The *prognosis* depends somewhat on the temperament of the patient. A man of nervous, irritable nature is more quickly worn down by stricture than one of placid, easy temper. A far more important condition than the temperament of the patient, is the extent to which the kidneys have suffered. Some evidence of this can be learned by careful examination of the urine, noting the quantity secreted, the amount of urea, the presence or absence of albumen. A third condition of weight is the narrowness of the stricture; another is its situation. Strictures, which involve the bulbous and membranous portions of the canal, are less safely treated than others which are seated in the penile portion of the urethra. If untreated, the consequences of stricture gradually develop and increase in severity, until death is caused by one of the several accidents already mentioned—rupture of the urethra and extravasation of urine, exhaustion by urethral fever, degeneration and acute inflammation of the kidneys, septicæmia, pneumonia, or cardiac disease.

On the other hand, if treated, stricture need not shorten life, and by removing the impediment to micturition, it is possible to arrest the development of the several consequences of that disordered function.

Treatment.—For treating organic stricture there are five methods available—viz. gradual interrupted dilatation, gradual continuous dilatation, forcible rupture or divulsion, internal urethrotomy, and external urethrotomy. In addition to these established methods there are others, such as destruction of the stricture with caustic, which has become obsolete, or by electrolysis, which is not yet of proved practical value.

In all methods of treatment, a permanent cure cannot be achieved unless the stricture be of very recent formation, and the conversion of the inflammatory thickening into contractile material not yet complete.

In the rare cases in which no contraction returns after expansion, the whole of the new product is probably absorbed, and the natural elasticity of the urethra is restored. But when the transformation from inflammatory plastic exudation into fibrous tissue has taken place, the stricture, however completely it may be widened to or beyond the natural dilatability of the urethra, must be expected to shrink again, either slowly or speedily, according to the individual or to the method adopted for its dilatation. Hence, the aim in treating stricture is to expand it to the natural width of the urethra, and to maintain it near to that size by the occasional passage of a sound or bougie.

1. *Gradual interrupted dilatation*—by passing instruments of increasing sizes at short intervals, is the mode applicable to the majority of cases. This method excites the least irritation; it is a simple plan and need not interfere with the patient's ordinary pursuits, while it gives some relief even when that relief is only imperfect and temporary.

The classes of cases to which the interrupted gradual dilatation is most suited are, early semi-inflammatory strictures, and strictures in the bulbous portion, where the kidneys are greatly diseased. In the latter, sufficient increase to the width of a stricture may be given by the passage of bougies to render life very endurable; but, at best, any plan of treatment is unsatisfactory in such cases. After this method of dilatation, whenever the stricture is caused by well-organised fibrous tissue, long intervals between the passage of an expanding instrument are not to be expected. Nevertheless, if he pass his bougie regularly, the patient may enjoy fair health and comfort for the remainder of his life. As a rule, gradual dilatation is useless for bridge strictures, for contraction of the meatus, and

for very dense perineal strictures. These latter obstructions resist dilatation by this method; any attempt to widen them beyond a very insufficient degree will cause great constitutional disturbance, pain, rigors, and high fever, with subsequent prostration. Again, certain strictures shrink back so fast, after dilatation by the interrupted passage of instruments, that no progress is achieved. For all these varieties, incision through them by the knife is to be preferred, since it gives an almost complete cure for the bridge stricture, greatly retards the rate of contraction of the elastic strictures, and, if practised with proper precautions, is less frequently followed by febrile reaction than is any other plan of treatment.

For the interrupted dilatation of strictures three forms of instruments are employed. They are rigid or flexible. The best rigid sounds are made of steel, as steel can be more highly polished than any other material. Silver and plated metal, especially pewter, grow rough or scratched in use. All metallic instruments should be immersed in hot water immediately after use and then wiped dry while hot. Heating them before use often greatly facilitates their passage. Steel sounds should be kept in a wash-leather case. The most useful shape of rigid sounds for dilating strictures is that which, for about eight inches from the handle, is perfectly straight and cylindrical; beyond that the sound should have a curve occupying a quarter of a circle of two and one-third inches in diameter—that is, the curve is one inch and seven-eighths long. The curve should be maintained to the very tip of the sound; and the latter should not be prolonged in a straight run after the curve is passed. A sound of this shape most easily passes through a stricture, and avoids catching against the neck of the bladder before entering it. The sound has a broad flat handle, that the fingers may control the instrument and easily direct the point. The upper surface of the handle, being parallel with the shaft, is at right angles with the tip or ‘beak.’ This disposition enables the operator to be constantly aware of the direction of the beak when using the instrument. The sound should be of the same thickness from beak to handle, and simply rounded at the point. It is true sounds are used of conical shape—i.e. at the curved portion the calibre increases slowly from the neck till the straight part is reached, the remaining straight portion having the same diameter along its length.

Conical sounds are supposed by those who use them to wedge the stricture asunder

more readily than a succession of sounds of cylindrical shape; but they have the serious disadvantage of not letting the operator feel the progress of the point of the sound, as the resistance of the stricture to the widening part at the curve masks any impediment that is caused by catching of the beak. For this reason conical sounds are dangerous instruments in not very practised hands. ‘Bellied’ sounds, like conical ones, are brought into use and fall out again from time to time. Their enlargement is confined to the curved part, and the straight part of the stem is slender, in order that, when several strictures have to be traversed, the resistance may be occasioned only by that stricture through which the belly of the sound is actually passing. As rigid sounds are less safe to use and more likely to cause pain and febrile disturbance than are flexible bougies, it is usual to confine their employment to strictures of only moderate contraction, attacking very fine or tortuous ones with pliant instruments.

Flexible bougies of various thicknesses are used for treating strictures by interrupted dilatation. They range between 1 millimètre in circumference and 25 or 30 millimètres. The smallest bougies are made of plaited silk, silkworm gut, catgut, or whalebone. The former materials are the most flexible, and do not fray or get rough, as do catgut and whalebone. Whalebone, which is a good deal stiffer than gut or silk, can be made temporarily supple by soaking it in boiling water for a quarter of an hour. Still, the rigidity and sharpness of its point render the whalebone bougie very apt to catch in a follicle or pocket of the urethra, and come to a dead stop. The best lubricator to prevent the instrument from rubbing or hitching as it enters the canal, and also to prevent the introduction of infectious matter, is ‘Lund’s oil’ (so named after the surgeon who first used it); a mixture of almond oil fʒjss., castor oil fʒss., and pure phenol (crystallised carbolic acid) ʒj.

To prepare the patient for treatment, every source of irritation should be removed. Violent exercise, especially long walks on the days the bougies are to be passed, must be avoided. The digestion should be good, diet plain, and free, or almost so, from alcoholic drinks. The urine should be acid, quite free from blood, and almost so from albumen. If the kidneys or bladder are irritated by the stricture, they must be relieved by rest in bed, warm baths, saline purges, &c. When there is

chronic retention or cystitis, the bladder must be regularly drained by small catheters until the urine is acid and nearly free from pus. Acute urethritis must also be subdued before the dilatation of the stricture is begun. The preliminaries being got over, and the calibre and situation of the strictures ascertained, the urethra is gradually accustomed to the passage of instruments. Not more than two or three sizes should be passed at the same sitting, and, at first, none large enough to be tightly grasped by the stricture. Usually two days should intervene between each sitting. As instruments are most easily passed in the morning, before the patient rises from bed, in difficult cases the operation should be performed at that time. Indeed, if much spasm attend the passages of the instrument, the patient had better keep his bed wholly during the early stages of dilatation. In most cases, it suffices that the patient have the instrument passed immediately after breakfast, before he begins his day's work. The best position for the patient is to lie flat on the back: the risk of fall from sudden fainting is thus prevented, and the muscles and fasciæ are more thoroughly relaxed. If the patient stand up, he should lean against a suitable object, with his legs about one foot apart.

In passing an instrument, there are three localities in the healthy urethra where its point is apt to catch. First, the navicular fossa just within the meatus, to be avoided by directing the point along the floor for the first inch of the urethra; the next is in the bulb, as the instrument approaches the triangular ligament; and the last is in the prostatic portion, before the bladder is reached.

When using sounds, to prevent a hitch at these places, the operator stands on the patient's left, holding the sound steadily but lightly with the thumb and two first fingers of the right hand across the patient's left groin, with the beak pointing downwards; while the penile portion of the urethra is drawn on to it with the fingers of the left hand, lightly holding the penis between them. By this means the point of the sound is gently pushed to the bulb, whence it then has to traverse the curved ascending portion of the urethra. If the right hand, holding the handle of the sound, be carried to the middle line of the patient and gently raised as the sound is pushed along the urethra, until the handle is vertically over the symphysis pubis, and then, in continuation of its curve, depressed till the handle is between the patient's thighs, the

beak will be kept in contact with the roof of the passage all along the urethra. By this precaution, the sound will not depress the urethra at the orifice in the triangular ligament, nor get fixed in the urethra below that orifice, until the handle is depressed between the patient's thighs sufficiently to tilt the point up, to enter the triangular ligament with a jerk and a cry of pain from the patient. This hitch strains the urethra, and may even tear it, by the long leverage which the sound exerts over the parts in which its point is entangled, as the handle is passing through an arc of a considerable circle. Again, in approaching the neck of the bladder, no resistance is felt if the beak be kept from the floor, otherwise the beak catches in the prostate, and, pushing that organ onward, slips into the bladder with another painful, sudden jerk.

These impediments are natural, and being known can be avoided, but the entry to a stricture is not known until discovered by exploration. It has been pointed out that the irregular growth of the fibrous tissue which forms the stricture often diverts the track to one or other side, thus throwing the beginning or 'mouth' of a stricture athwart the proper direction. If the point of the sound catch in this obstruction, it is stopped in its progress; and if force be used with a fine instrument, the wall of the urethra may be penetrated, and the instrument pass between that canal and the rectum, or into the rectum itself. The 'false passage' so made, remains a pitfall for future embarrassment; the immediate result being for the patient great pain and free bleeding, with not infrequently a sharp attack of fever and abscess, and for the surgeon, failure to reach the bladder. When made by the surgeon, false passages usually start from the floor or from the left side; when by the patient operating on himself, on the right side or in the floor. Recollection of this fact will usually enable the surgeon to avoid the wrong route, by keeping the beak of his sound steadily away from the opening, as he approaches the stricture. In difficult cases, by passing the finger into the rectum the position of the catheter in a false passage can be ascertained, and the beak can often be guided along the urethra. Something may be gained by watching the position of the handle of the sound; if the upper surface is directed to one or other side of the middle line, the beak of the instrument is turned from the course of the urethra against or through its wall.

Even when no false passage exists, the position of the entry to the stricture should be sought for methodically, and, when discovered, carefully noted for future guidance. To do this, the beak should be carried along the roof in the first instance, then along the left side, and then along the right side; leaving the floor to the last, as that is the least likely part at which to effect an entrance. If there be spasm which contracts the stricture closely, a hot sound, passed lightly but swiftly down the urethra, will often surprise the stricture and slip through it without being held. Of course, this resource is only available with strictures of fair width, No. 14 or 16 French, as fine sounds are too apt to pierce the wall of the urethra and do serious mischief, if carried swiftly along the urethra. Indeed, so easily is damage done by using fine rigid instruments in the treatment of strictures, that it is best to reserve their use for cases where flexible ones have been tried in vain. The special and important advantage of rigid instruments, is the power which they give to the surgeon of directing the point in any way he chooses. But, as already mentioned, the sound, some ten or twelve inches in length, is a powerful lever, and sufficiently strong to tear the urethra at the perineal fascia, if forcibly raised and depressed when it is not gliding steadily along the urethra. Much practice and delicacy of touch are needed to safely handle fine silver catheters and sounds.

To pass flexible bougies, the steps of the method are at first the same as those for sounds, directing the point against the floor till the fossa navicularis is passed, then pushing it straight onwards. If it catch at any part—usually the floor of the bulb—the bougie should be withdrawn a little, and, while rotated between the fingers and thumbs, again pushed onwards. If the bougie persistently catch at one point, it must be withdrawn and the point given a little twist or bend. On a second introduction the point will not travel precisely as before, and will probably fail to catch where it was checked at the first attempt. It is well to have bougies with points somewhat bent or twisted spirally, in order that, by rotating the stem, the point may be carried beyond the pocket or round the face of the stricture, and so avoid resistance to its onward passage. Also, when bougies with tapering ends fail, those of equal thickness throughout will often pass, especially if a slight curve be given to the bougie by softening it in hot water, then bending it with the fingers, and, while thus held, stiffening the curve

by plunging the bougie into cold water. If the arrest is caused by the bougie being too thick to pass the stricture, and not by its point being stopped at an obstruction, a different sense of resistance is felt. In the former the point enters the stricture, and is so grasped that force is required to extract it. If the point is stopped, the bougie comes away at once or is even partially ejected by the urethra, which, having been pushed towards the bladder, recovers its natural position.

When the bougie or sound has fairly passed the stricture—i.e. its thickest part is introduced into the narrowest portion of the canal—it should be withdrawn at once. No benefit follows the retention of the instrument, unless it remains in the urethra for the rest of the day, when enlargement of the stricture is attained by another process—that which is set in action by tying in the catheter continuously, to be presently described. On the contrary, spasm and pain are often excited by the bougie being left for a few minutes in the urethra. At the next sitting, the process of dilatation is continued by first passing the largest bougie of the previous sitting, and following it up by one or two of greater thickness, according to the readiness with which the urethra yields to the expanding force. This process of interrupted dilatation is carried on until the No. 24 or 25 can be introduced easily. The patient should then be trained to pass one of these sizes for himself, and, when perfect in his lesson, dismissed with the injunction to repeat the operation once a month, once in two months, every quarter of a year—in short, just so often as he finds needful to prevent shrinkage of his widened stricture.

During the course of expansion it may happen that, while the deeper and narrower strictures continue to yield, one near the meatus, or the meatus itself, refuses to expand before the enlarging bougie. The gradual dilatation thus comes to a standstill. This difficulty is got over by cutting these bands till the meatus, or contraction near the meatus, allows a bougie of the size of the unaltered portions of the canal—No. 28 or 29—to pass it. The further dilatation of the deep stricture can then be proceeded with, and the incised obstructions kept open by passing through them a sound of the size mentioned, until the cuts have healed. Again, strictures, where there is copious formation of cicatricial tissue, often yield up to a certain width, too narrow for safety; but any attempt to stretch them beyond this extent causes violent febrile

disturbance, rigors, vomiting, and other signs of renal irritation and congestion. Such strictures must be cut by some of the methods described under URETHROTOMY. Experience shows that in these cases of irritation from bougie-stretching, the speedy division of the stricture by the knife is seldom followed by more than slight rise of temperature, and hardly ever by rigors and high fever, if proper precautions be taken in the after-treatment.

When dealing with strictures of extreme narrowness, through which the urine escapes only by drops, it very rarely happens that an instrument cannot be introduced into the bladder, if sufficient perseverance be exercised. To succeed, it is needful to have a good supply of fine bougies, varying in shape and material, but all of great tenuity down to No. 1 or less of the millimetrical scale, made of the materials, and with points varying in shape, in the manner already described. The more pliable the bougie is near the point, the more likely is it to insinuate itself into the devious path of the stricture. Various manœuvres are also useful. One is to inject a teaspoonful of oil into the passage before the stricture is attacked by the bougie; the oil distends the anterior part of the urethra and percolates along the stricture. In doing this it often opens the little granulation that overlies the mouth of many strictures, and allows the bougie to slip past. In other cases, the bougie will sometimes run in during the act of micturition.

When spasm is readily excited by instrumentation, chloroform should be employed to annul it. But chloroform has the disadvantage of rendering the patient unconscious of the surgeon's proceedings, when his warnings are often of service to the latter in avoiding false passages.

It is useful to pass a silver tube of the size of No. 14 or No. 12 down the urethra as far as the stricture, and push through it the filiform bougie to the stricture. The point of the bougie is thus prevented from catching in pockets or irregularities, before it arrives at the stricture itself.

A still better plan in very narrow strictures, after repeated failures with the fine bougie, is to pass an endoscope-tube down to the stricture, dilating the anterior portion of the urethra as a preliminary if necessary, and so illuminate the face of the stricture. The mouth is generally readily seen, and the filiform bougie, directed by the eye, enters the stricture with surprising facility. See ENDOSCOPE.

Directed by the fact that the mouth of a stricture is generally placed at the side of the urethra, not near the middle of the passage, an American surgeon has invented an instrument called the 'pathfinder.' This consists of a straight tube of the size of No. 20, the further end of which is closed by a disk, that can be made to revolve round the axis of the tube by a screw at the handle. In this disk, away from the centre, is a hole large enough to allow a filiform bougie to pass through it. In use, the straight tube is passed along the urethra until it arrives at the stricture; the disk is then made to revolve slowly, while a long fine bougie is kept continually peeping from the little orifice. As the disk revolves, it carries the end of the bougie slowly round the face of the stricture; and, being thus brought against several parts of the stricture, the fine bougie probably enters the mouth, and can be pushed on through the stricture, when the pathfinder can be withdrawn over it from the urethra. The drawback to this ingenious instrument is that strictures are seldom single. The large tube is checked in its passage to the fine stricture by a less narrow one placed nearer the mouth of the urethra. This of course can be widened by gradual dilatation or incision, and the narrow one got at, but, in practice, cases of such extreme difficulty as to need the aid of the pathfinder are extremely rare.

When the resources of flexible instruments have been exhausted, silver catheters of great fineness may be used. They can be made three or two, or even only one millimètre in circumference. They should be supplied with a well-fitting stylet that runs closely to the end of the catheter, lest its interior be filled with clot or mucus, and the outflow of urine prevented when the stricture has been penetrated and the bladder reached. The outer end of the catheter may be fitted with a mouthpiece, to which a little syringe can be attached. By this syringe a few drops of urine can be sucked from the bladder, and the interior of the tube cleared of obstruction. As these instruments are as sharp as knitting-needles, they must be used with a very light hand, and never *driven* along the urethra. A very moderate force suffices to push the point through the urethra and cause serious damage.

When, by any means, an instrument reaches the bladder through a very narrow stricture, it should be tied in the urethra until it is loose; then it should be replaced by a somewhat larger one, or the dilatation

be continued by the interrupted method. Even if the instrument be only a bougie, not a catheter, the urine finds its way by the side of the instrument more and more freely the longer the bougie remains.

2. *Gradual Continuous Dilatation*.—This plan consists in tying a flexible instrument in the stricture, and replacing it with a larger one every two or three days, until the natural calibre of the urethra is restored. The change of catheter is needed lest it slip out when very loose in the stricture, and also for purposes of cleanliness. This method occupies about ten or twelve days, and is easy, rapid, and generally safe. It requires a few precautions—(a) the catheter should always be a loose fit; that is, two or three numbers smaller than the stricture; if a tight fit is employed, the patient suffers much from pain and irritation, often sufficient to compel the interruption of the treatment; (b) the patient should be confined to his room, and for most of his time to his bed; (c) the catheter, as it lies in the stricture, should leave the neck of the bladder free. Of course, the catheter must be pushed into the bladder when it is desired to draw off urine, and withdrawn when the bladder is emptied, and its mouth stopped by a little spigot.

The process by which this dilatation is obtained is, probably, similar to that which goes on in parts where a seton or other foreign body has been placed. The fibrous tissue becomes swollen and juicy; its cells enlarge, and the intercellular spaces are charged with leucocytes. The further disintegration of the fibrous tissue into pus quickly widens the contraction, and causes a purulent discharge from the urethra.

The drawbacks to this rapid and easy dilatation prevent reliance on it alone for the whole course of treatment; though for the first stage of widening a very tight stricture it is very appropriate. These disadvantages are—(a) the rapidity with which a stricture enlarged by continuous tying in shrinks back when the process is over; usually so rapidly that the patient cannot keep himself free from danger and discomfort; (b) a few patients cannot support the presence of a catheter in the urethra for more than two or three consecutive days. In such persons, *malaise*, pain at the neck of the bladder, or general febrile reaction, which may be very severe, compels the removal of the catheter and, when subsidence of the irritation allows the treatment to be resumed, the adoption of some other method. Notwithstanding

these disadvantages, tying in is useful when rapid dilatation is needful to drain a bladder attacked with cystitis after long retention, or where the large amount of renal disease renders urethrotomy hazardous.

3. *Forcible dilatation* is a method which seeks to widen the stricture by stretching the fibrous tissue sufficiently at one sitting to restore the calibre of the canal. As fibrous tissue is quite inelastic, 'stretching' really means tearing the bonds asunder slowly instead of ripping them apart instantaneously as in 'divulsion.' To effect 'forcible dilatation' a split sound is used, the halves of which, when lying close together, equal No. 12, but can be separated, for about three inches of their length, by a lever worked by a screw until the width equals No. 26 or more. In use, the sound is passed in its contracted condition far enough for the expanding part to lie in the stricture. The blades are then slowly separated, until in the course of ten or fifteen minutes the strictured part is stretched to the natural expansibility of the urethra.

4. *Divulsion*: the instantaneous ripping asunder of the narrowed part, is effected by a variety of instruments working on the same principle—viz. forcibly separating the halves of a small split sound by thrusting a wedge rapidly between them.

Both forcible dilatation and divulsion have the great disadvantage of being followed by rapid re-contraction, and divulsion is very liable to the untoward consequences which occasionally attend the gentlest instrumentation of the urethra. Indeed, rigors and suppression of urine, with fatal result, are more frequent sequelæ of divulsion than of any other method of treating stricture.

For treating strictures by cutting operations, the reader is referred to the article on internal and external URETHROTOMY.

In reference to the numerous list of complications which may follow any method of widening strictures, it must be recollected that the urethra is of extremely delicate, highly nervous structure, easily damaged or irritated, and that no method is quite free from risk of painful or dangerous consequences. Of the less serious complications are slight hæmorrhage, soreness and pain in passing urine, fainting or syncope, spasm of the perineal muscles, causing more or less difficulty in voiding urine for some hours or days after the passage of an instrument. These symptoms usually subside spontaneously in a few hours without further mischief; but the hæmorrhage, if

the erectile tissue at the bulb be injured, may be so abundant as to greatly exhaust the patient and even endanger his life. The syncope may be attended by more serious nervous disturbance, such as violent vomiting, great prostration, great anxiety and depression of spirits, and copious clammy sweats. The difficulty in micturition from spasm of the deep perineal muscles may amount to total retention of urine. The shock, which sometimes follows even the passage of a bougie over the bulbo-membranous portion of the urethra, may cause reactionary pyrexia, showing itself as URETHRAL FEVER or as SUPPRESSION OF URINE. The latter varies from a small diminution in quantity of the renal secretion to the complete arrest of the renal secretion and a speedily fatal termination. The presence of albumen or blood in microscopic quantity in the urine passed during the next few hours, indicates the renal congestion of moderate amount which follows the diminished secretion of urine even when that is but slight. The local troubles are not few nor of light importance. They include inflammation of the testicle, abscess in and around the prostate or perineum, with, it may be, septicæmia as their final termination. BERKELEY HILL.

STRICTURE-DILATORS. — Under this name are included instruments which act upon strictures in very different ways; some of them are true dilators, but others, of which Holt's instrument for the urethra is best known, really act by rupturing the stricture.

The instruments employed for the rapid dilatation of strictures of the urethra are — conical metal sounds, Wakley's tubes, Thompson's expander, and Holt's and Berkeley Hill's dilators.

Lister's conical sounds are solid instruments made of plated steel; their curve is accurately adapted to the urethra, and their weight and the smoothness of their surface greatly facilitate their introduction; they cause very little irritation, and patients upon whom they have been used often prefer them to soft instruments. The sounds have bulbous ends with narrow necks, beyond which they increase gradually in size until about the opposite end of the curve, where they are three sizes of the English scale larger than at the points. Two, and sometimes three, instruments may be passed successively at one sitting. By this method, which is one of true dilatation, the stricture may, in suitable cases, be rapidly and safely brought up to the full size.

Wakley's dilator consists of a small silver catheter which serves as a guide, and of a series of tubes of gradually increasing sizes. The guide is first passed through the stricture, and then a steel rod is screwed on to its proximal end. Over this, one of the tubes is passed onwards through the stricture, and, when in place, it serves as the conductor over which another and larger tube may be passed, and so on through the whole series until the stricture is sufficiently dilated. It is possible to use this instrument in two ways. One or two tubes only may be passed at one time, and then the effect would probably be one of true rapid dilatation; but if the whole series are successively introduced at one sitting, it is difficult to conceive that the urethra will escape laceration.

Thompson claims for his instrument that it acts by over-distending the stricture — that is, by stretching it to four or five sizes beyond what is natural to the urethra at the part affected, without causing unnatural dilatation of other parts whose normal calibre is less. This instrument is composed of two blades, which can be separated most widely at the desired spot by means of a lever, which is itself worked by turning the handle. It should only be used for strictures situated in the bulbous portion of the urethra, and the blades of the instrument should be slowly separated so that their action may be, as much as possible, one of dilatation, though, undoubtedly, some laceration of the urethra at the seat of the stricture must be caused.

Holt's instrument consists of two blades joined at the extremity, and, lying between them, of a wire, which serves as a guide, along which a tube (No. 12 English scale) may be passed in such a way that the blades of the instrument are rapidly wedged asunder. The two-bladed instrument is first passed through the stricture, and then the wedge is forcibly thrust home, and any resisting bands are ruptured.

Berkeley Hill's dilator consists of a split sound, the halves of which can be separated by passing between them a wedge which is fixed on the extremity of a steel rod. The wedge is dovetailed to the blades of the sound, and seeing that friction only occurs at these points instead of all along the instrument, as in Holt's dilator, the force required to use it is comparatively slight.

Sir H. Thompson and Mr. Berkeley Hill have both abandoned rapid dilatation in the treatment of stricture of the urethra, and there is a widespread belief that rapid dilatation, or, more correctly, rupture of stric-

tures, has in many cases been followed by disastrous consequences. Rupture of a urethral stricture is often followed by intense shock; in many cases suppression of urine has resulted from it; and in others pyæmia has followed it. But in addition to the dangers attending forcible rupture of a stricture, the degree and permanence of relief afforded by it has been less than that gained by other methods of treatment. In fact, the only recommendation of forcible dilatation is the ease and rapidity with which it may be accomplished.

Fibrous strictures of the rectum are commonly treated mechanically by the introduction of bougies of gradually increasing sizes, in combination with, or independently of, notching of the constricting band in a few places; but there is an instrument known as Todd's dilator which is adapted to produce more rapid dilatation. It consists of two blades, which are joined together by four crossbars in such a way that a parallel motion and separation of the blades may be effected by turning a screw in the handle. Before introducing this instrument into the stricture, its blades should be closed and covered with an india-rubber sheath, so as to protect the mucous membrane against being caught between the blades of the dilator.

BILTON POLLARD.

STROMEYER'S CUSHION is used, as a support for the upper limb, in the treatment of compound fractures of the humerus and the elbow-joint. It is a triangular cushion with two of its angles rounded off, and stuffed with horsehair. One of the rounded off angles is placed in the axilla, and the upper limb, flexed to a right angle at the elbow, is laid on the cushion. The cushion is maintained in position by two tapes, which pass from its axillary angle over the opposite shoulder; and by other tapes, which pass round the body from the two lower angles of the cushion. The whole apparatus is supported in a sling.

STRUMA. See SCROFULA.

STUMPS, Affections of.—A stump is said to be a good one when the soft parts are freely movable over the end of the bone, without any redundancy of tissue, when pressure can be borne directly on the face of the stump, and when the cicatrix is not over the end of the bone.

After the lapse of a year or two, a stump will be found to have undergone considerable change. The muscles and soft parts atrophy, and the cut ends of muscles

and tendons have taken up new attachments either to the bone, or to the fibro-cellular tissue of the end of the stump. The bone becomes rounded and the medullary canal closed by a layer of compact tissue, and from disuse it often undergoes fatty atrophy. The ends of the nerves are thickened and more or less bulbous, the swollen ends consisting of fibrous tissue, with nerve-fibres intermixed. The vessels also diminish in size, and their ligatured ends dwindle, until at last they are represented only by fibrous cords as far as their nearest branches. The stumps that undergo least change are those which are formed of skin-flaps only, or those which are obtained by union between a natural bone-covering and the sawn section of a long bone, as in a Pirogoff or in Gritti's amputation at the knee.

Treatment of a Recent Stump.—The dressings should be of some antiseptic form, and great cleanliness exercised in changing them. Rest for the stump is essential, and muscular spasm is best controlled by the application of suitable splints. Efficient drainage must be provided, but the tubes should not be kept too long a time in a stump. In ordinary cases, when the flaps are well approximated, and there is no constitutional disturbance, they may be shortened or dispensed with at an early dressing. When, however, there is a cavity in the stump, as in a Syme's amputation, or in an amputation through the knee-joint, the drainage must be continued for a longer time. Through carelessness, or from not properly securing the ends of the drainage-tubes, a piece may be left forgotten in a stump and give rise to troublesome suppuration.

Hæmorrhage that occurs a few hours after an amputation is best treated by removal of the dressings, elevation, and exposure of the stump to the air. If the oozing seems general, then firm compression may be applied; but if there be reason to suppose that a vessel has escaped ligation, the flaps must be opened, and search made for the bleeding point. This is especially necessary if there be great distension by clot; the removal of all clot, provided proper precautions are taken to maintain an antiseptic condition of the wound, will greatly expedite the reparative process. See HÆMORRHAGE.

Secondary hæmorrhage, at an interval of several days after operation, necessitates careful watching, and often prompt action on the part of the surgeon. If it be small in quantity, the expectant treatment is

indicated, but a renewal of the bleeding, or any excess indicating lesion of a large vessel must be dealt with by careful search for the bleeding point. However unhealthy the condition of the stump, the bleeding vessel can generally be found, and by a little dissection secured. The thorough cleansing and drainage obtained by opening the flaps is often followed by rapid healing. See ARTERIES, Wounds of.

If hæmorrhage occur at a later period when the stump is nearly healed, then an incision may be made in the course of the vessel and a ligature placed at a slightly higher point, or the artery may be ligatured at some convenient position as near the stump as possible.

Necrosis of Stump.—From the irritation of the saw, or when the periosteum has been stripped from the bone above the point of section, a limited necrosis of the end of the bone may occur, and delay take place in the healing of the stump until the dead bone has separated. A limited necrosis may also result from the projection of the end of the bone through the anterior flap, secondary to ulceration of the coverings from pressure; occasionally an extensive central necrosis ensues, attended with much constitutional disturbance and profuse offensive suppuration. A considerable time will then elapse before the sequestrum can be extracted, but still eventually a good stump will result. The thickening of the bone by periosteal deposit, and the tenderness elicited by pressure over it, the retraction of the soft parts, the necrotic appearance of the end of the bone, and the escape of pus from the medullary cavity, will make the diagnosis clear. In certain of these cases, but fortunately now of rare occurrence, acute necrosis after amputation is attended with such severe constitutional disturbance and evidence of septic absorption, as to necessitate a higher amputation, and an amputation if possible at the joint above the bone affected. Such a procedure is, however, only justifiable when life is endangered by the septic process, or by the exhaustion produced by prolonged suppuration. See OSTEOMYELITIS.

An *adherent cicatrix* may be the result of undue prominence of the end of the bone, or be caused by any of the conditions giving rise to conical stump. Such a cicatrix is often tender to the touch, prone to ulceration, and entirely prevents any direct pressure being borne on the end of the stump. When much inconvenience is occasioned, removal of the cicatrix, if the

parts are redundant and permit of it, will be requisite. In many cases, it will be desirable to take away a sufficient portion of bone with the cicatrix.

Eczema of stump may be induced by the irritation of the dressings, and is apt to take on a chronic course, especially in persons predisposed to it, or when there is an ulcerated condition of cicatrix keeping up continued irritation.

When eczema occurs in consequence of the dressings, boracic lotion should be substituted for any stronger antiseptic that may have been in use.

Painful Stump.—A recent stump may be excessively painful from inflammatory exudation. When acute necrosis occurs, then pressure on the end of the bone, or manipulation during the dressings will occasion the most intense suffering. For the first few days after an amputation through a muscular part like the thigh, the involuntary movements caused by spasm of the muscles are often very distressing to the patient, but can be controlled by the application of splints. The possibility of pain and spasm, due to the inclusion of a nerve in a ligature, must also be remembered.

A stump may become painful, and remain so long after it has healed, and yet nothing be found to explain the condition. The patient is generally a young or middle-aged female of hysterical temperament. Careful search should be made for any point of local tenderness, especially in the cicatrix, since the implication of some nerve-twigs in the cicatricial tissue might be the cause of the condition, and relief be afforded by the excision of the portion of cicatrix involved. In conical, and sometimes in well-shaped stumps, the nerve-ends may become greatly enlarged and painful, so that pressure on them gives rise to a peculiar electric form of pain. The bulbous nerve-ends often constitute a true form of neuroma, and contain numerous nerve-fibres as well as fibrous tissue. Free excision of the tuberos swelling or swellings would then be necessary.

Malignant disease of a stump may be a local recurrence after amputation for malignant disease in the immediate neighbourhood, or epithelioma may attack the cicatrix of a stump that has been the seat of chronic irritation. Re-amputation when possible will, of course, be advisable.

The time at which an artificial limb can be adapted to a stump, will vary according to the particular case and the amount of direct pressure to be borne.

An interval of three months after complete cicatrisation is advisable, and no expensive instrument should be ordered for at least a year. The stump will then have shrunk to something like its permanent dimensions. Amputations at the ankle-joint, and at or through the knee-joint generally, give a stump capable of bearing the whole or nearly the whole weight of the body; but in an amputation through the leg or thigh, no matter how the flaps have been fashioned, the bearing points of an artificial leg must be distributed carefully on the bony points above, and little if any pressure be allowed on the end of the stump. See ARTIFICIAL LIMBS.

Conical Stump.—After amputations through the shaft of a single bone, such as the humerus or femur, the stump generally becomes a little conical in time, owing to the atrophy of the soft parts. In young subjects, with active growth of the bone going on, this condition of stump is sometimes extreme, the end of the bone, covered by stretched skin or thin cicatricial tissue, projecting very much like the stick of a half-opened umbrella; and this may take place in a stump that was originally well-formed.

A stump may become conical owing to the shortness of the flaps, or from the bone not being sawn through at a sufficiently high level, from bad after-treatment, or from the recession of the soft parts during the healing process, especially when this is prolonged, and when the amputation has been performed through parts previously inflamed, or when the patient is in an exhausted, unhealthy condition.

Treatment.—By proper attention to the dressing of a stump, much may be done to prevent its becoming conical. By injudicious bandaging, strapping, or over-manipulation during the dressings, almost any slowly healing stump may be made conical. To correct such a tendency, the limb should be carefully bandaged from above downwards, and in some cases extension by means of strapping may be made on the flaps. Subsequently, if it be found that the bone is very prominent, and especially if there be a troublesome cicatrix adherent to the bone, a sufficient portion of the bone must be removed. This may best be effected by making a dependent incision along the side of the bone away from the chief vessels, separating the periosteum with the soft structures by careful use of an elevator, and sawing through the bone at the desired level; care being taken to protect the soft parts from

injury by the saw. When the conical condition is caused by increasing growth of the bone, it is best to defer operation as long as possible, since the deformity is likely to recur, and further interference is then rendered necessary.

BERNARD PITTS.

STY. See EYELIDS, Diseases of the.

STYPTICS are astringents which are applied, either in the solid form or in solution, to the surfaces of wounds with the object of arresting bleeding; or are taken internally in the belief that they increase the coagulability of the blood, and so are beneficial in cases of hæmorrhage from internal organs.

Styptics act locally in two ways — (1) by stimulating the walls of the blood-vessels and causing them to contract; (2) by combining with the albumin of the blood and forming a coagulum in the mouths of the vessels. It is only the bleeding from small vessels and capillaries that can be checked by means of styptics, and to act efficiently on those vessels the styptic must be carefully applied. The clots should be removed from the wound and the cut surfaces should be mopped dry, and then the styptic should be rapidly applied so that it may come into contact with the blood in the mouths of the vessels—the object being to form a plug of coagulum within them. If the surface of the wound be not mopped dry, the blood will coagulate upon it as a film, beneath which the bleeding will continue.

Styptics can only be recommended as a means of arresting hæmorrhage in quite exceptional cases, since they act injuriously upon the wound. They act as weak caustics on the tissues, and hence tend to produce superficial sloughing; the clots formed in the vessels are not fibrinous, but consist of a combination of the styptic with the albumin of the blood, and in consequence they cannot be such a good medium for the formation of reparative tissues as a healthy clot would be. However carefully, too, the styptic be applied, it is difficult to prevent the formation, on the surface of the wound, of a coagulum which will act there as a foreign body. All these conditions are fatal to union by the first intention, which is, of course, the surgeon's aim in the treatment of wounds. Styptics should, therefore, never be applied to a wound till other less objectionable methods have been tried and have failed. There are, however, certain regions in which it is

impossible to apply other means of arresting hæmorrhage efficiently, and then styptics are of value.

In cases of vesical hæmorrhage dependent on new growths, it may be impossible to arrest the bleeding by other means, and then an injection composed of a drachm of the solution of perchloride of iron to an ounce of water is of much use. In post-partum hæmorrhage from the uterus, if the uterine contractions cannot be provoked, and an injection of an antiseptic solution at a temperature of 105° to 110° Fahr. has failed, an intra-uterine injection of perchloride of iron (one part of the solution of perchloride of iron to three of water) should be tried. Its use is not, however, unattended with risks. In obstinate bleeding after extraction of teeth, when careful packing of the tooth-sockets has failed to check the flow of blood, a plug of cotton-wool soaked in a solution of perchloride of iron often arrests it at once. Hazeline, the active principle of *Hamelis Virginica*, is a good styptic, and may be employed instead of iron for the last-named purpose. The writer has found hazeline most successful in arresting bleeding in a patient, the subject of hæmophilia, who had, on a previous occasion, a bleeding of such severity and persistence that he had to remain in hospital for some months. In bleeding from leech-bites, in situations where pressure cannot be effectually applied, the hæmorrhage can often be quickly stopped by touching the bleeding points with the solid stick of nitrate of silver. Powdered matico-leaves, tannin, gallic acid, alum, and spirits of turpentine may be enumerated as styptics, and the last-named has many times proved successful in controlling hæmorrhage which has resisted other means of treatment.

Wherever it is possible, styptics should be applied on cotton-wool, which should be fixed in position with firm pressure; but if the bleeding be from an internal cavity, such as the bladder, a soluble styptic must be injected into it. With regard to internal styptics, it is only necessary to state that they are useless in the treatment of such cases of bleeding as are met with in surgical practice.

BILTON POLLARD.

SUBCLAVIAN ANEURISM. — In this class of aneurism are included only those cases in which the innominate artery is not involved; that is to say, it excludes all cases of aneurismal dilatation commencing in the arch of the aorta or the innominate artery, and extending into the subclavian. It also excludes all those

cases in which the dilatation begins below the level of the lower border of the first rib. It is necessary to be somewhat precise in thus limiting the lower level of the subclavian artery, as very different anatomical points are adopted as the seat of its termination, especially by continental writers. Thus Kocher, in his elaborate essay on subclavian aneurisms, makes the artery terminate at the lower border of the pectoralis minor, and therefore includes many cases of what would be ordinarily termed axillary aneurisms. It frequently happens, however, that an aneurism commencing in the subclavian extends downwards into the axillary artery, and to these the term subclavio-axillary aneurism has been applied.

Subclavian aneurism is of fairly frequent occurrence, and is said to occupy, in order of frequency, an intermediate place between carotid and innominate aneurism. Considering the strains to which the subclavian artery must be subjected in the varied movements of the upper extremity, it seems surprising that more cases, the direct result of violence, are not met with. The aneurism may be seated in any part of the artery on the *right* side of the body, or it may occupy the whole course of the vessel from its origin to its termination. On the *left* side it is stated that aneurism only occurs in that part of the artery which is external to the thorax, and that the intra-thoracic portion is never the seat of aneurismal dilatation, except as a secondary result of primary dilatation of the arch of the aorta. The most common situation, however, for aneurism of the subclavian on both sides is in the third part of its course, external to the outer border of the scalenus anticus muscle. The aneurisms are usually of the fusiform variety, and are often of comparatively small size.

Causes.—Aneurisms of the subclavian artery are generally connected with extensive disease of its coats, and also of those of the arteries on the proximal side of the swelling, and to this pre-existing morbid condition of the vessel most of these cases are due. Thus of 121 cases tabulated by Poland, in 33 there were distinct proofs of atheroma, in 14 there was aneurismal dilatation of the aorta, and in 25 the aneurism was stated to be spontaneous and without any history of an injury, and therefore was presumably due to disease of the coats of the vessel. Of 43 cases out of the 121 in which the disease was ascribed to traumatic causes, in 13 atheroma was discovered, in 3 aneurismal dilatation elsewhere, in 23 there was no evidence as to

the presence or absence of atheroma, and in only 4 were the vessels declared to be healthy. It has been stated by some that the much greater frequency with which subclavian aneurism occurs on the right side (in the proportion, it is said, of three to one) is evidence that the disease results in a great measure from traumatic causes, from prolonged or repeated exertion of the right arm, or violent strains of this extremity. But the greater frequency of aneurism on the right side of the body may be explained in another way. The mechanical strain to which the arteries are subjected on the right side of the body is greater than on the left, on account of the larger amount of use to which the right upper extremity is put; and this may be the cause of a more extensive amount of atheromatous degeneration in the coats of the arteries on this side, which renders the vessels more inelastic, and predisposes them to a more frequent occurrence of aneurism on the right than the left side of the body.

The greater frequency of subclavian, as well as of other aneurisms, in the male than the female may be explained in the same way—that is to say, the greater strain to which the arterial system is subjected in the male, on account of the laborious occupations in which he is engaged, renders the arteries more liable to become the seat of atheromatous change.

Symptoms.—An aneurism of the subclavian artery is characterised by a swelling, generally ovoid or fusiform in shape, and usually situated in the subclavian triangle, just above the clavicle, and between the posterior border of the sterno-mastoid and the anterior border of the trapezius. It is often of small size, but may vary from that of a bean to an orange; after becoming diffused, it has been said to attain the size of a football or a child's head. When small, it may disappear behind the clavicle when the shoulder is raised; but generally, when the patient is standing erect in a position of ease, it presents itself as a prominent swelling above the clavicle, and can be distinctly seen to expand at each impulse of the heart. It presents the ordinary symptoms of aneurisms in general, consisting of a circumscribed, compressible swelling, with a distensile pulsation, and having the other characters which are described under ANEURISM. Its pressure effects depend on the part of the vessel implicated. When the disease is confined to the third part of the artery, the brachial plexus and its branches may be pressed upon, producing numbness and sometimes

pain down the arm and in the fingers, with weakness and loss of motion in these parts. There may be also pressure on the subclavian vein, and œdema of the hand and arm may be present. The external jugular vein is also commonly involved and becomes distended and varicose. When the aneurism is seated on the first portion of the vessel, the internal jugular and vertebral veins are pressed upon, giving rise to œdema and lividity of the head and face, and congestion of the brain, producing sometimes a semi-comatose state. It may irritate the phrenic nerve, causing a spasmodic action of the diaphragm; or, on the right side, the recurrent laryngeal nerve may be involved, causing a paralysis of the vocal cord on that side. It may likewise interfere with the trachea or œsophagus, producing stridulous breathing or dyspnoea and difficulty in swallowing, and finally it may press on the clavicle or first rib, causing erosion of these structures.

Diagnosis.—Two points have to be considered in the diagnosis of subclavian aneurism—1st, its diagnosis from other tumours, and 2nd, its exact situation and diagnosis from aneurism in other vessels. The most common swelling for which subclavian aneurism may be mistaken is enlarged glands, which are often found in this situation. The character of the pulsation and the fact that, as a rule, the enlarged glands can be lifted off the vessel, when all pulsation ceases, is generally sufficient to establish the diagnosis. Chronic abscess may also be mistaken for aneurism, and aneurism for chronic abscess; but, by attention to the history of the case and careful manipulation, the true nature of the tumour can be made out. Mayo relates a case, in which an exostosis on the first rib pushed forwards and flattened the subclavian artery, and caused a prominent and pulsating swelling above the clavicle much simulating subclavian aneurism. A subclavian aneurism may be mistaken for a carotid or innominate aneurism, or even for one of the aorta itself, and it is often a matter of great difficulty to ascertain from which of these vessels the tumour springs. A sign of importance, in diagnosing between carotid and subclavian aneurism, is the character of the distal pulse. If the radial pulse is weaker on the affected side than on the other, the aneurism is probably subclavian; whereas, if there is a marked difference in the temporal pulses of the two sides of the body, it is probably carotid.

Prognosis.—At first small, a subclavian aneurism may for some time remain almost

stationary, or only increase very slowly. After a time, however, it augments rapidly, and has a tendency in many cases to become diffused. In the earlier stages, and sometimes even after it has been increasing rapidly, a spontaneous cure may take place. In some of these cases, pulsation suddenly ceases, as if the distal vessel had become blocked, and the swelling subsides; in other cases, there is a gradual diminution in the pulsation and an abatement in the severity of the symptoms, and the aneurism becomes solid and compact. When a subclavian aneurism becomes diffused, it loses its defined shape, contracts adhesions to surrounding parts, and approaches nearer and nearer to the surface. It may burst externally, or into the pleural cavity, bronchi, or trachea. It may cause death from pressure on the windpipe and suffocation, or from irritative fever and exhaustion.

Treatment.—Probably there is no class of external aneurisms in which the surgical treatment is so unsatisfactory and the outlook so gloomy as in subclavian aneurism. All the various means of treating external aneurism have been resorted to, with a very small amount of success and with repeated failures, and it becomes a question whether it is not more expedient to abandon these measures, and to treat the cases on the ordinary principles of internal aneurism, by rest, attention to diet, and medicine. At all events, in the majority of cases the surgeon will best fulfil his duty to his patient by endeavouring, in the first instance, to bring about this condition of so-called spontaneous cure by these means. But should they fail, or should the disease be spreading so rapidly as to preclude any attempt to cure the aneurism in this way, the question of surgical treatment will have to be considered. All the various plans of treating external aneurism have been adopted in these cases: pressure, either direct or indirect, both on the cardiac and distal side of the aneurism; proximal or distal ligature; injection of ergotin into the neighbourhood of the sac; manipulation; galvano-puncture and amputation at the shoulder-joint, have all been resorted to, though with a very scanty amount of success.

1. *Direct pressure*, where the aneurism implicates the third portion of the vessel, has been said to succeed in some cases, and its employment holds out a certain prospect of success. At all events, it can do no harm, and ought always to be tried in the first instance, either alone or as an accessory to proximal or distal pressure.

It may be applied either by means of a weight, such as a bag of shot, or by a leaden cap. It is, however, difficult to apply satisfactorily, and in some of the cases in which a cure has been said to have been effected by these means, there is considerable doubt whether the recovery was not to be attributed to other causes.

2. *Pressure on the Cardiac Side of the Aneurism.*—On account of the position of the artery, compression can rarely be applied in this situation, and it is only in exceptional cases that the artery rises so high as to permit of pressure on its cardiac side. Poland records a case in which it was entirely successful, but this success was mainly due to the 'probable existence of a supernumerary cervical rib, and the unusually lengthened and abnormal course of the subclavian artery.' Acupressure, or direct compression of the exposed innominate artery, has been adopted in two instances by Porter and Bickersteth. In Porter's case the pressure was made after the artery had been exposed, by an instrument resembling a small lithotrite. The patient died on the tenth day from secondary hæmorrhage. In Bickersteth's case the pressure was made by a leaden wire passed round the vessel, and this, by means of a series of india-rubber springs, was made to compress the vessel so as to control the circulation. On the second day the wire broke, and the innominate artery was then ligatured. Death took place on the sixth day afterwards from hæmorrhage.

3. *Distal compression* by itself can hardly be expected to succeed, but may be useful as an adjunct to cardiac or direct pressure. Porter records a case in which the size and pulsation of the tumour was temporarily reduced by compression of the axillary artery, by means of a probe passed under the vessel, after it had been exposed and bridged over by a loop of wire. The benefit was only temporary, and the tumour recommenced growing.

4. *Proximal ligature* is the treatment which has been tried most extensively, but with almost uniformly bad results. Four different operations have been performed—viz. (a) ligature of the innominate; (b) ligature of the first part of the subclavian; (c) ligature of both subclavian and carotid, just beyond their origins; (d) ligature of subclavian, carotid, and vertebral, just after their commencement. To these T. T. Sabine proposes to add a fifth—viz. ligature of the carotid, the subclavian, and all the branches of the latter, except the superior intercostal. The innominate has been

ligatured in sixteen cases, and in every instance but one with a fatal result, and in that the common carotid was also tied, simultaneously, an inch above the bifurcation, and the vertebral artery on the fifty-fourth day, to control secondary hæmorrhage.

Ligature of the first portion of the subclavian has been uniformly fatal in all cases but two, from secondary hæmorrhage. It seems right, therefore, to banish this operation from our means of cure, until some form of ligature can be adopted which will be successful in preventing secondary hæmorrhage.

Ligature of the carotid and subclavian, just beyond the bifurcation of the innominate, has been advocated by some as a means of cure in subclavian aneurism. The object in tying the carotid is to render more certain the formation of a proximal clot in the innominate artery. Probably this end is achieved, but, the branches of the subclavian remaining pervious, so much blood is returned into this vessel as to prevent the formation of a distal clot, and secondary hæmorrhage therefore results. In three cases in which this plan was adopted, the treatment was unsuccessful.

In cases of subclavio-axillary aneurism, or aneurism low down on the subclavian artery, ligature of the second portion of the vessel by dividing the outer half or two-thirds of the scalenus anticus muscle is practicable, and has been followed by good results. Poland records twenty-one cases, of which nine recovered.

5. *Distal ligature* has been resorted to in a few cases, with uniformly bad results, and indeed it seems scarcely possible that any good can be expected from this plan of treatment, which would apparently have the result of increasing rather than diminishing the aneurism. For, between the sac and the ligature are the numerous large branches of the axillary, which would continue to be supplied by blood passing through the aneurism in such quantities as to preclude the chance of any consolidation taking place.

6. *Injection of Ergotin* into the tissues in the immediate neighbourhood of the sac has been employed, and in three cases by Langenbeck has been said to be successful. More extended observation requires to be made before it can be proved that any decided beneficial results are to be obtained from this plan of treatment. It is possible in those cases where recovery has been said to follow this operation, that the cure was spontaneous.

7. *Manipulation* was first recommended by Sir William Fergusson for the cure of

subclavian aneurism. It has been adopted in some few cases, and in one case (Littre's) with the most satisfactory results. The treatment in most of the other cases, even if it has not been beneficial, at all events has done no harm, and it would therefore appear that it undoubtedly deserves a further trial. The cases in which this treatment is most applicable are those where there is a thick sac-wall, pointing to the probability of fibrine having been deposited in its interior, and where the aneurism is easily accessible.

8. *Galvano-puncture* has been tried in these cases, in one instance with success. The result of the same treatment in aneurisms elsewhere is not such, however, as to encourage us to hope for any but the most temporary relief from this measure; though at the same time it must always be regarded as a possible means of cure in cases which cannot be treated in any other manner. See ELECTROLYSIS; ACUPUNCTURE.

9. *Amputation at the Shoulder-joint.*—This formidable measure was first suggested by Sir William Fergusson, as a mode of treatment in cases of subclavian aneurism which are inaccessible to any other plan of treatment, and in which the aneurism is rapidly increasing and evidently must soon terminate the existence of the patient. It must be confessed that this is a desperate measure, since it involves the loss of a most important member (in very many instances the *right* arm), and ought to be reserved for those cases in which it is quite evident that the aneurism is rapidly increasing, and that other means are of no avail; or, in those cases where the limb is gangrenous, or threatens to become so. Certainly, it seems preferable to adopt this measure rather than to resort to any of the formidable operations of ligature of the arteries on the cardiac side, to which allusion has been made, and which have almost invariably terminated fatally.

To sum up. It would appear that in cases of subclavian aneurism an attempt should first be made by rest, careful dietary, and medicinal treatment, to bring about the so-called spontaneous cure. Failing this, if the aneurism is situated in the third part of the artery, direct pressure, and then manipulation, should be fairly tried, since these measures hold out the best prospect of success. If the disease is in the first portion they cannot, however, be adopted; and it may be right to perform the distal operation by tying the third portion of the subclavian, as a preliminary to amputation

at the shoulder-joint. If these various plans have been thoroughly tried, and in spite of all treatment the aneurism is increasing, amputation at the shoulder-joint holds out a better hope of preserving the patient's life and curing his aneurism than any form of proximal ligature, and ought certainly to be adopted.

T. PICKERING PICK.

SUBCLAVIAN ARTERY, The.—

This vessel carries blood to the upper extremity, to the side of the neck, and to the brain. The right vessel starts from the bifurcation of the innominate, the left from the aortic arch beyond the left common carotid. Each artery is divided into three stages by the anterior scalene muscle. The relations of the first stage differ on the right and left sides, but the second and third stages on the two sides are similar.

I. The first stage of the right subclavian passes from the innominate to the inner border of the anterior scalene muscle. It extends forwards, upwards, and outwards from the right sterno-clavicular articulation.

In *front* are the cutaneous structures and the muscles attached to the inner end of the clavicle; but immediately on it are the internal jugular and vertebral veins, the pneumogastric nerve, and sympathetic cardiac nerves. *Behind*, the longus colli muscle, the sympathetic cord, and the recurrent laryngeal nerve. *Internally*, the common carotid artery and the trachea. *Externally* and below, the pleura and the recurrent laryngeal nerve.

The first stage of the *left subclavian* passes from the aortic arch to the inner border of the left anterior scalene muscle; its length is three and a half inches. In *front* are the left lung and pleura; *behind*, the longus colli, the œsophagus, and the thoracic duct; to the *outer* side is the pleura; on the *inner* side is the trachea, œsophagus, thoracic duct, recurrent laryngeal nerve, and the left carotid artery. The pneumogastric and phrenic nerves, and the internal jugular and subclavian veins, converging to form the left innominate, are on a plane anterior to the vessel.

LIGATION.—On the right side the artery is exposed by the same operation as that described for the INNOMINATE. On the left side the vessel is exposed as follows:—Place the patient in the recumbent position; depress the shoulder; make an incision from the sternal notch upward along the inner edge of the sterno-mastoid for a distance of three inches; another, a horizontal incision, is commenced one inch above the lower

end of the former, and carried outwards for a distance of two inches, half an inch above the clavicle. Reflect the flap, with the sterno-mastoid detached from its origin; avoid or tie the anterior jugular vein; divide and raise the sterno-hyoid and -thyroid muscles; with the forefinger feel for the inner edge of the anterior scalene muscle; pull inwards the internal jugular vein. Pass the needle from before backwards—i.e. below upwards—avoid the phrenic, and keep close to the vessel to avoid the pleura.

II. The second stage of the artery is that behind the anterior scalene muscle; in length it is about three-fourths of an inch.

In *front* is the anterior scalene muscle, and on the muscle lie the phrenic nerve, and the transversales colli and humeri arteries. *Behind*, the cord of the brachial plexus formed by the eighth cervical and first dorsal. *Below*, the pleura, and *above*, the brachial plexus.

LIGATION of the second stage is performed by steps almost identical with those for ligation of the third, until the outer edge of the scalene muscle is reached. It is then necessary to cut the muscle for some distance. To do this, feel for the scalene tubercle, pass a director behind the muscle, and nick, or cut it to the extent of half an inch or even two-thirds of its breadth; the danger of cutting too far lies in wounding the phrenic nerve. The lower down the muscle is cut the safer is the nerve.

III. The third stage of the subclavian passes from the outer border of the anterior scalene muscle to the outer border of the first rib. The length is about two inches.

In *front*, are: the skin; superficial fascia with clavicular branches of the superficial cervical plexus of nerves; platysma; deep fascia. The clavicle, the subclavius muscle, the supra-scapular artery, and the subclavian vein run nearly parallel courses in front of the artery. The external jugular vein and the nerve to the subclavius cross it. *Behind* is the middle scalene muscle, separated by the lowest cord of the brachial plexus. *Below*, the first rib and the first serration of the serratus magnus, and *above*, the cords of the brachial plexus.

LIGATION.—Place the patient in the position of repose, with the shoulder depressed. The operator takes his stand between the abducted upper limb and the trunk. Pull the skin down over the centre of the clavicle; cut for a distance of three inches along the centre of the clavicle, severing the cutaneous structures and the platysma. Allow the skin to retract; avoid the transversalis colli

and humeri veins if possible, and open the deep fascia. With a director or knife clear the tissues between the posterior belly of the omo-hyoid and the clavicle. Draw the muscle mentioned upwards; feel for the scalene tubercle and the arterial pulsations, and clearing the front of the artery and opening its sheath, pass the needle, with the left forefinger on the scalene tubercle, from behind forwards to avoid the brachial plexus. It is best to pass the needle obliquely. Difficulties and dangers: (1) Wounding the external jugular vein by cutting too far forwards. (2) Wounding an abnormal cephalic by cutting too far out. (3) Venous bleeding to a great extent from the transversalis colli and humeri veins. Veins, when bleeding, are to be compressed or tied. (4) Finding the omo-hyoid bound down, or attached, to the clavicle. (5) The sterno-mastoid muscle or the trapezius, or both, may require cutting, owing to their wide attachments to the clavicle. (6) Picking up the lowest brachial cord. (7) Wounding the subclavian vein. (8) Difficulty in seeing the needle-end when it is passed, owing to a deeply-placed artery in a short, fat neck, with a high clavicle.

JAMES CANTLIE.

SUBCONJUNCTIVAL ECCHYMO-SIS (Hyposphagma).—The rupture of a small vessel under the bulbar conjunctiva is a frequent occurrence. It suddenly gives to 'the white of the eye' a more or less extensive purple hue, which causes the patient much concern. It is common in old people, but may occur in the young, and even in children, from severe straining, as in hooping cough, vomiting, or raising heavy weights. It is of not the slightest importance, doing no damage to the eye.

Treatment.—If no measures be taken, the extravasated blood gradually becomes absorbed. The process may be hastened by the application of a tight bandage.

H. R. SWANZY.

SUBCUTANEOUS INJECTION. *See* HYPODERMIC INJECTION.

SUPERIOSTEAL RESECTION.—Since the beautiful experiments of Ollier, there has always been a fascination for subperiosteal operations, partly on account of the regeneration of bone, and partly on account of the intimate relation which the tendons have with the new bone obtained by this method. But opinion has changed very much as to the desirability of subperiosteal resection in the treatment of joints. There is no mechanical difficulty in

the operation when it is done for disease, for the periosteum, being thick and vascular, peels off very readily from the bone. But, in the case of primary excision for injury, the periosteum is with difficulty preserved uninjured, being in no way distinguishable from a loose connective tissue. In such cases, the amount of bruising and laceration, to which it is necessarily exposed by the use of the raspatory and elevator, defeats the object with which it has been so carefully preserved, and as a consequence the periosteum frequently dies.

First, then, as to *joints*, the advantages of this particular method of excision, even when successfully accomplished, are very doubtful, for the amount of bone that may be and often is thrown out around the new joint will, if excessive, increase the difficulties of obtaining a movable joint. In the knee, where complete osseous ankylosis is desired, there is very little periosteum to preserve, so that, in the only joint in which such new bone would be an advantage, there are no means of doing a subperiosteal resection. *See* JOINTS, Excision of.

Another very serious objection to this method in the case of diseased joints and carious bones is that, in preserving the periosteum, some risk is run of a return of the disease when the new bone is produced.

Consequently, as far as joints are concerned, this method of operating is not in such general favour as it was some years ago, when first suggested by M. Ollier. And the experience of most surgeons is that the older operation, in which the periosteum is not so carefully preserved, yields as good if not better results than the more tedious and prolonged operation of subperiosteal resection.

In some cases of excision of a joint, a considerable portion of the shaft of a bone may require removal. Under such circumstances, the periosteum should be carefully preserved, to prevent the shortening of the limb that might otherwise occur; but the instances in which this is necessary are very few in number, and do not invalidate the argument that has been previously given as to the objection against the general adoption of subperiosteal resection of joints.

For *caries of bone* this method of removing the disease may be of service, as, for instance, in excision of the os calcis; but there is some danger of a return of the disease, as has been already pointed out. *See* CARIES, Causes of. But there is not much evidence forthcoming as to this possible result, so that the objection may after

all be a fanciful one. The periosteum is very easily lifted from the bone, and should, as far as possible, be left connected with the tendo Achillis, this connection with the new bone being one of the main objects of the operation.

In *acute necrosis*, this operation will be found of undoubted value. Where the whole or greater part of the diaphysis of a long bone has suddenly become necrosed in acute diffuse PERIOSTITIS (as has been pointed out in the article on that subject), the dead part may be exposed and quickly removed in the earliest stage of the disease before any new bone has been formed by the inflamed periosteum. The long and tedious course of the disease is thereby considerably shortened, and instead of waiting till the periosteum has formed an invaginating sheath, which is the representative of the new shaft, as was formerly the practice, the dead bone is at once removed, and the suppuration thereby reduced to a minimum. A very natural fear has always been entertained that the new shaft would not be of the same length as the old one, even if its thickness and strength were equally good. When two bones exist side by side and only one is affected, as in the case of the tibia and fibula or the radius and ulna, this fear would appear to be groundless; and the experience of many surgeons has proved that, in these instances, the healthy bone maintains the length of the limb while the periosteum of the other is forming new bone. In single bones, such as the femur and humerus, a very large portion of the shaft has been successfully removed before the periosteum has formed its invaginating sheath, and no shortening has been observed. But the writer is not aware that any surgeon has successfully performed subperiosteal resection in the manner above indicated of the *whole* shaft of either the humerus or the femur without a very considerable shortening of the limb.

Transplantation of bone was thoughtfully designed for a case of this kind by Dr. William Macewen of Glasgow, and successfully carried out in 1879 and 1880. The whole shaft of the humerus had been removed from the upper and lower epiphyses by subperiosteal resection, and doubts were at that time entertained as to the integrity of the periosteum. The wounds healed completely in a few months, but bone was only reproduced for about an inch and three quarters from the head of the humerus. From this point down to the condyles it was completely absent, leaving a deficiency of

over two-thirds of the humeral shaft. The arm was therefore to a great extent useless, for there was no fixed point from which the elbow could act. The condition was the same a year afterwards, when the first operation of transplantation of bone was successfully accomplished. Wedges of bone, with the periosteum which covered them, were removed from some cases of deformed tibiæ which were at that time under the care of Dr. Macewen, and utilised for the purpose. These were cut into small fragments and inserted in a groove that had been previously made between the muscles of the arm, immediately adjoining the upper extremity of the humerus.

'The former presence of bone was nowhere indicated, and the sole guide as to the correct position into which the transplant was to be placed was an anatomical one.' This operation was performed three times, when the gap was completely filled up. The ultimate result at the end of a year and four months was a most brilliant success, for the bone was firmly united throughout its whole length, and only half an inch shorter than its fellow. See *Bone-Grafting* under GRAFTING.

If transplantation in this way proves on further experience to be as successful as it was shown to be in this case, then there will no longer be the same objection to removal of the whole shaft of a long bone as there appears to be at the present time.

In *amputation* through the shaft of a long bone, periosteal flaps may be advantageously made, a method which is distinctly derived from the other subperiosteal operations. It diminishes the chance of subsequent necrosis of the sawn surface of the bone, covers over any little irregularity of the section, and, by the rapid formation of new bone at the end of the stump, produces a rounded end to the bone more quickly than is obtained by the older method of amputation. After making a circular sweep round the bone, the periosteum may be pushed back with the elevator, and the saw applied. If done in this way there is very little delay, and the operation is not materially lengthened. H. H. CLUTTON.

SUBUNGUAL EXOSTOSIS.—This almost always occurs on the great toe, arising with a sessile base from the last phalanx. It is common in early life, and more frequent in girls. Its structure is that of spongy, cancellous bone, tipped with a layer of cartilage. Its size is usually that of a small currant. As it occasions, if allowed to persist, much inconvenience in

walking, it should be removed early, and completely as well, otherwise recurrence and sarcomatous changes are very likely to occur. Ether being given, and as much of the nail removed as will thoroughly expose the exostosis and its base of origin, a deep groove is to be cut round the exostosis with a small, strong-backed scalpel, and removal completely effected with fine-cutting bone-forceps. The foot should be kept quiet for a few days on a back splint, and one of the following dressings made use of: iced lead-lotion, carbolic oil (1 in 40), or a saturated solution of boracic acid applied by means of two thicknesses of lint, the deeper one of which is only removed once in twelve hours, the other being resoaked and re-applied every two or three hours.

W. H. A. JACOBSON.

SUPPOSITORIES are preparations of drugs, which are moulded in the shape of small cones suitable for administration by the rectum.

The Pharmacopœia authorises suppositories containing morphia, lead and opium, tannic acid, mercury, carbolic acid and iodoform; but many other drugs may be advantageously administered, in the form of suppositories or pessaries, which differ from suppositories only in their larger size, and in being used in the vagina instead of in the rectum.

Cocoa butter is very frequently used as the menstruum for suppositories; it melts quickly, and so the full effect of the drug which it carries will be quickly obtained. Curd soap is ordered in the Pharmacopœia for tannic acid and carbolic acid suppositories. Morphia suppositories are directed to be made either with cocoa butter or curd soap. Curd soap dissolves slowly, and so the local effects of drugs mixed with it will be more prolonged. Suppositories may also be made of gelatine and glycerine, in the proportion of one part of the former to four of the latter.

Nutrient suppositories may be efficiently and easily made in either of the following ways:—1. Take equal weights of concentrated peptonised milk and cocoa butter; warm the cocoa butter in a mortar and mix the peptonised milk with it; then divide and mould the mixture into suppositories weighing a drachm and a half. Each suppository will be equivalent to about an ounce and a half of milk. 2. Take equal parts of Koch's meat peptone and cocoa butter; warm the latter and mix the peptone with it, and mould the mixture to the required shape.

Rectal medication is useful when, from any cause, medicine is rejected by the stomach, or when the local effects of the drugs are required.

Suppositories may be either anodyne, purgative, astringent, disinfectant, or nutritive. Morphia (gr. $\frac{1}{2}$) and belladonna (gr. $\frac{1}{2}$ to 2) are the most useful anodynes; but if their employment be objectionable, iodoform suppositories (gr. v.) will often be found useful. After operations on the rectum, anus, urethra or bladder, the introduction of a half-grain morphia suppository into the rectum is followed by great relief from both pain and spasm. A similar suppository is very valuable for allaying the pain consequent on disease of the surrounding organs—e.g. in acute cystitis with strangury and in painful chordee.

The introduction of a piece of soap into the rectum is a well-known popular remedy for constipation. Suppositories containing aloine (gr. j.), elaterium (gr. $\frac{1}{2}$), gamboge (gr. v.), or podophyllin (gr. j.), may, in suitable cases, be employed as rectal purgatives.

Astringent suppositories may be employed for catarrh or simple ulceration of the rectum or vagina, and disinfectant ones may be serviceable in malignant ulceration of the rectum or uterus, &c.

Nutrient suppositories offer no advantages over nutrient enemata, except the ease with which they may be administered. In introducing a suppository into the rectum, it should be oiled and pushed well beyond the internal sphincter; a little support should be maintained for a few seconds until any reflex contraction of the rectum has subsided. When the sphincter ani has been divided, as in the operation for fistula, the suppository must be passed well up into the rectum, and the anus must be supported by a pad and bandage.

BILTON POLLARD.

SUPPRESSION OF URINE, or the failure of the kidney to secrete—also spoken of sometimes as anuria—is produced in several ways. It may be due to chronic organic disease of the glandular portion of the kidney or to disturbance of its innervation or vascular supply, or, finally, to sudden obstruction of the ureter, leading to complete arrest of its functions. The first of these causes is easy to understand: the organ has more or less gradually undergone fibroid change, as the result usually of one or other form of interstitial or catarrhal nephritis; but of the other two it is not easy to speak definitely. This much, however, may be said, that whether we speak of disturbances of

vascular supply or of innervation, the immediate cause of the suppression of urine has been found to be, in many cases verified by necropsy, an intense congestion of the kidney; in other rarer cases it is probably anæmia of the organ. Thus, in the acute fevers, such as scarlatina, where anuria has proved a fatal symptom, renal congestion has been observed, probably in this case due to the direct action of the morbid matter of the disease upon the renal capillaries; this seems the more likely when we remember that the same effect is produced by overdoses of turpentine, acetate of lead, or the mineral acids. In all these instances the deeply congested organ is unable to excrete more than perhaps a few drachms of dark, highly concentrated and blood-stained urine as long as the hyperæmia lasts. But, in suppression from severe shock to the system after injuries, the matter is not so clear, and requires further study; possibly in these cases anæmia of the organ is the cause. The difficulty surrounding these questions is much enhanced by the fact that the amount of blood found in the kidney *post mortem* seems to vary considerably within the range of health, the organ sometimes looking very pale or turgid where we have no grounds to suspect morbid change.

One form of disturbance of innervation producing suppression, not infrequently met with, gives us, perhaps, a clue to the whole question, and this is the effect upon the kidney of violence to the urethra. Every surgeon is familiar with the fact that after operations upon the urethra ranging from the simple passing of a catheter to bursting of a stricture, or internal urethrotomy, more or less complete suppression of urine is seen from time to time, and this in the healthiest individuals. In these cases the patient may not secrete more than a few drachms of high-coloured blood-stained urine for many hours after the operation, and may exhibit much constitutional disturbance; he may even die unrelieved. If this be so, we find nothing but intense congestion of the kidneys to account for the anuria. Nothing appears to account for these phenomena so fully as the theory of reflex vaso-motor disturbance of the organ; but the exact mechanism of the change requires further study.

In the case of suppression from *sudden* blocking of the ureter by a stone or fragment of growth, the effect upon the kidneys appears to be practically the same. Only a few drachms of urine are found in the ureter and pelvis; but this urine is usually clear, pale, without albumen, deficient in urea, and

of low specific gravity. The kidney in some of these cases is found enlarged and deeply congested, in other cases anæmic and mottled, and not larger than usual. It is somewhat hard to reconcile these differences, but it may be that both the congestion and anæmia are merely the result of different stages of the same reflex disturbance of nervous balance in the kidney, due to stretching of the urethral walls from sudden impaction of stone, just as in the case of violence to the urethra.

The *symptoms* of suppression of urine are usually very trifling until several days have elapsed. Gastric disturbance, loss of muscular vigour, and insomnia are often seen early; but the characteristic evidences of uræmia are often delayed until perhaps a week has elapsed. When they once appear they become intensified, and death takes place in a few days, usually from the ninth to the eleventh. The characteristic signs of uræmia are muscular twitchings, contraction of the pupils, loss of muscular power, and, as a consequence, laborious breathing. Insomnia is usually very distressing, but coma and convulsions are exceptional; diarrhœa and vomiting are rare unless produced artificially; anorexia is only a very late symptom. The skin often acts profusely, and there is no dropsy or ammoniacal odour from the surface of the body or breath; the pulse has a tendency to rise, and the temperature to fall, as also the respirations (Roberts).

The *prognosis* where suppression is extreme is very bad. Cases are known to have recovered where it has lasted for seven or even fifteen days, but death takes place in the majority of cases before the eleventh day.

The *treatment* of suppression of urine depends of course upon the cause. It resolves itself into local and general. If due to chronic interstitial change, but little can be done locally beyond protecting the loins from sudden changes of temperature. The general treatment will embrace warm baths or vapour baths, the use of pilocarpine and all other measures promoting excretion from the skin; laxatives may also be cautiously employed, but not diuretics as a rule. The diet should be light, consisting chiefly of milk; stimulants should be very cautiously used. Where we have reason to suppose that anuria is produced by renal congestion, wet cupping over the loins, or bleeding from the arm in strong individuals, and dry cupping in the anæmic are most valuable. These measures should be followed up by hot belladonna fomentations over the loins

and abdomen and the general treatment recommended above. The use of instruments should be avoided as far as possible. Where suppression follows upon the impaction of a stone in the ureter, the treatment is directed in the first place to efforts to relax the contraction of the ureter by antispasmodics—as belladonna, chloroform, or even opium used cautiously, together with hot baths of one kind or another. In the second place an attempt should be made to dislodge the calculus by mechanical means, i.e. by placing the patient's body in various positions while kneading over the track of the ureter is practised with the hand: the patient may also be encouraged to active exercise. If these measures fail and the evidence of the presence of a stone is clear, it may be justifiable to cut down upon it from the loin, and either extract the stone or establish a urinary fistula in the flank, if the former be impracticable.

ARTHUR E. BARKER.

SUPPURATION.—Inflammation is said to terminate in suppuration when the exudation is sufficiently corpuscular to form a yellowish fluid—pus. This may escape from a mucous or cutaneous surface, or an open wound; or it may accumulate within an organ or natural cavity—e.g. a joint—in the form of an abscess.

In the case of interstitial inflammation, it is generally conceded that the whole or greater part of the pus is composed of migrated leucocytes and liquor sanguinis; that, in fact, the connective-tissue corpuscles, instead of responding to the irritation by proliferating, remain perfectly passive throughout the entire process. On the other hand, it seems clear that, in catarrhal inflammation of the skin and mucous membranes, the epithelial cells—which, by the way, are physiologically subject to perpetual growth and multiplication—furnish a by no means inconsiderable number of the cellular elements of pus.

There are several circumstances, one or more of which determine suppuration, and favour its continuance when established.

(1) *The degree of injury* to the vessels must be such as to entail exudation of plasma and leucocytes, too copious for the lymphatics to carry off the surplus beyond what can be accommodated by the tissues, consistently with the maintenance of their vitality. If the irritation be too great, stasis rapidly supervenes; the blood coagulates in the vessels, and acute interruption of the exudation ensues. The tendency then is to gangrene.

(2) *Continuation of the irritation.*—A tissue, especially if previously healthy, may be able to withstand a severe injury, and quickly recover from the effects of it, provided the cause be at once removed. On the other hand, if it be allowed to act indefinitely, the power of resistance becomes less and less; the walls of the vessels are so damaged, and the circulation hampered by the pressure of the exudation, that resolution of the inflammation may be impossible.

(3) *The entrance of air* into a wound is a very important factor, as the records of clinical surgery abundantly prove. This is nowhere better exemplified than in fracture of the bones. Even comminuted *simple* fractures habitually unite without the occurrence of suppuration; whereas pus-formation is the rule in compound fractures, and a certainty if the wound is allowed to remain open and unprotected by antiseptic dressings. It is not merely the entrance of air, as that in itself is not harmful, but the admission of organisms contained in the atmosphere, organisms which possess the property of setting up fermentative changes in the products of inflammation. There is thus added to the mechanical injury the irritation by decomposed organic matter. Conversely, the inflammation may be reduced, and, it may be, entirely subdued, by arresting these putrefactive changes.

(4) *Tension* exerts a potent influence on the course of suppuration. It is well known that, so long as an acute abscess remains closed, the signs of inflammation continue unabated. When it bursts or is opened, they subside with surprising quickness. The improvement is not confined to the local lesion, for the constitutional disturbance—the fever—shows at the same time a corresponding decline in intensity. The higher the tension the greater the febrile symptoms and the pain; hence, the importance of the early evacuation of abscesses situated beneath resisting structures like the periosteum, dense fasciæ, &c.

(5) *Friction* is another cause of retarded healing of suppurating wounds. Ulcers of the leg, e.g., continue to secrete pus whilst the dress is permitted to fret the granulating surface. The obstinacy with which sinuses remain open for want of rest and apposition of their walls is proverbial.

(6) *The constitutional condition* of the patient and the *state of local nutrition* must not be neglected here. The result of any injury to a person in good health, and one reduced by acute disease or the subject

of profound cachexia, will be widely different. Depressed vitality, general and local, is at once the cause and consequence of continued suppuration; hectic fever, e.g., whilst it indicates prolonged discharge of pus, tells against the chances of repair of tissues. The cicatricial formation in the wall of a chronic abscess, by diminishing the vascularity, offers an effectual bar to the growth of vigorous granulations.

Scrofulosis greatly increases the pyogenic tendency, and thus underlies the development of suppurative fever.

In *diffuse interstitial suppuration*, the lymph or granulation-tissue melts away so rapidly that there is no chance for limitation of the action of the irritating products; whereas the walls of an acute local abscess, although being continually changed into pus (Billroth), offer a greater resistance to the absorption of irritant matter.

In the so-called pyogenic membrane, or suppurating zone of an acute abscess, the granulation-tissue contains only the remains of the old vessels. So long as suppuration is going on, there is only destruction. New-formed vessels are evidence of repair.

Pus, the anatomical product of suppuration, varies in composition according to the rate at which it is secreted, and the tissue in which it is formed, and whether or not it has been exposed to the air. Healthy, laudable pus, e.g., from an acute abscess, is a creamy, yellowish, somewhat viscid fluid; specific gravity 1,030 to 1,033. It contains about 88 per cent. of water, and a little over 8 per cent. of albumen. The latter fact should be borne in mind when considering the existence or extent of albuminuria in cases of 'pus in the urine.' Traces of leucin, tyrosin, and other products of the dissolution of proteid matter are present. It is rich in chloride of sodium, and is alkaline in reaction. Liquor potassæ forms with it a gelatinous mass. If allowed to stand, it divides into two strata, the upper a clear fluid—*liquor puris*—the lower a yellow sediment. On microscopical examination, it is seen that the deposit consists mainly of opaque corpuscles $\frac{1}{2500}$ to $\frac{1}{3500}$ inch in diameter. They are granular from the presence of fatty and albuminoid particles. Acetic acid clears up the latter and brings into view the nuclei, two or three in number. Some of the corpuscles contain only one nucleus, and resemble leucocytes in every way, their nuclei being visible, as a rule, without the aid of reagents. The fat-granules can be dissolved from pus-cells by ether or liquor potassæ. The cor-

puscles of Gluge are merely inflammatory cells swollen and crowded with granular fat. Cornil and Ranvier refer the multiplication of the nucleus to a vital process; others look upon it merely as the result of disintegration after the death of the corpuscle. Pus-cells are devoid of a capsule.

The pus from a closed acute abscess contains *micrococci*, which are incapable of setting up putrefaction. Rod-shaped *bacteria* are found in abundance in pus that has been exposed to the atmosphere; they are the active agents of septic decomposition. In some cases of infective septicæmia, longer rods, *bacilli*, are met with.

Pus-corpuscles may be pigmented by the colouring matter of the blood, when hæmorrhage has taken place into an abscess or wound. *Blue pus* owes its peculiarity to the presence of *micrococcus cyaneus*, a fungus not found in the contents of a closed abscess. The pus from cerebral abscesses is usually of a greenish tint.

FLUIDS RESEMBLING PUS.—(1) *Disintegrated, liquefied, decolorised blood-clot*. This was mistaken as the proof of suppurative endophlebitis, until Goodsir exposed the fallacy. (2) *Atheromatous matter*, which consists largely of the fatty débris of degenerated cells and cholesterine plates. (3) *Turbid serum*, which in reality is serum charged with pus-corpuscles, endothelial cells, and, it may be, films of fibrin. It is furnished by the serous membranes, pleuræ, &c. (4) The secretion obtained *post mortem* from the Fallopian tubes and renal papillæ. The creamy appearance is due to fatty epithelial cells. (5) *Inspissated milk*, like that composing a galactocoele.

PUS FROM A CHRONIC ABSCESS has often the unpleasant odour of the fatty acids. It varies in consistence from serum to firm cheesy matter; when thin, the fluid portion holds in suspension flocculi of fibrin, fat-granules, very few cells, crystals of cholesterine, and it may be of hæmatoidin and stearic acid. There may be shreds of necrosed tissue. When the suppuration is connected with bone, lime-salts are in excess, and minute sequestra are sufficiently common. Finally, inspissated pus may undergo calcareous infiltration. Microscopical organisms are absent.

The pus from a *gouty abscess* is gritty, being laden with needle-shaped crystals of *urate of soda*. AUGUSTUS J. PEPPER.

SUPPURATIVE FEVER.—Fever is not an essential concomitant of suppuration, for it is usually absent during the formation of a chronic abscess, and there is

no pyrexia associated with the discharge of pus from a healthy granulating wound.

PRIMARY SUPPURATIVE FEVER, such as occurs in the course of an ordinary acute abscess, is not infective; nor is it due to absorption of the products of putrefaction. The pyrogenous matter taken up from the seat of suppuration is incapable of multiplication in the system.

The body temperature rises to about 103° F., but there are no steep fever curves, the morning remission being usually 1°. It remains at its height until the matter is discharged, when it suddenly falls, and soon reaches the normal, if there be ample drainage and the cavity be protected from infection. The relief from the high tension checks absorption. If the fever be high and the abscess large, the patient may experience chills or even severe rigors.

SECONDARY SUPPURATIVE FEVER.—*Hectic fever* is septic, but not infective. The proximate cause is absorption of decomposing—not necessarily putrefying—pus, charged with bacteria. Exceptionally, it follows close in the wake of primary traumatic or primary suppurative fever, but far more frequently it is the consequence of long-continued absorption of septic matter in small doses. It is seen to perfection in the disintegration of the walls of large open abscesses, especially where drainage and disinfection of the discharges are difficult: hence its connection with bone-disease—e.g. caries of the spine, and suppuration in the joints. Constitutional debility is largely concerned in its incidence and progress. Hectic fever is absent so long as a chronic abscess, however large, remains closed. See **HECTIC FEVER**.

Symptoms.—The fever is remittent in type. The temperature, which in the evening is 103° F., or even higher, may fall to the normal in the morning. There is a tendency to regularity in the diurnal variation, so that the register is a series of steep curves. The general symptoms, which are more marked in the evening, are those of exhaustion. The want of tone in the vasomotor system is evinced by the flushed cheek, profuse sweatings, and soft rapid pulse. Lithates are deposited in the urine. The patient's strength is further depleted by colliquative diarrhoea. There is great muscular weakness and rapid emaciation. The pupils are dilated and the eyes glistening. In fatal cases death takes place from asthenia.

The *prognosis* is always grave. It is worse in scrofulous subjects, and in all cases

where it is impossible to remove the cause of the suppuration.

Treatment.—The indications are (1) to secure free escape for the pus; (2) to render the pus aseptic; (3) to check excessive secretion from the skin and bowels; (4) to support the strength by nutritious, easily digestible food, tonics—of which quinine is the best—and alcoholic stimulants in quantity proportionate to the degree of exhaustion; (5) to prevent the formation of bed-sores. For the profuse sweating belladonna is the appropriate remedy. When the temperature is high, tepid sponging affords decided relief. But chief reliance must be placed in quinine given in 5- to 10-grain doses.

AUGUSTUS J. PEPPER.

SURGICAL FEVER.—The various forms of pyrexia, which occur in 'surgical' disorders, are sometimes grouped together under the title of Surgical Fever. The employment of this term, however, is obviously disadvantageous, as unwarrantably involving the assumption that there is a difference of kind in the pathology of pyrexia met with in 'surgical' cases, from that which characterises most 'medical' ailments.

The following are the varieties of pyrexia which are met with in practical surgery:—

1. **SIMPLE TRAUMATIC FEVER.** See **TRAUMATIC FEVER**.

2. **ASEPTIC FEVER.** See **ANTISEPTIC SURGERY**.

3. **SEPTIC FEVER** (q.v.)—(a) *Sapraemic Fever*, see **SAPRÆMIA**; (b) *Septicæmic Fever*, see **SEPTICÆMIA**; (c) *Pyæmic Fever*, see **PYÆMIA**.

4. **NEUROTIC FEVER**, including **URETHRAL FEVER**.

Pathology.—Considering the want of exact information on the subject of heat-production in the body, and considering how little is known of heat-regulation under *pathological* conditions, it would be out of place here to review the various theories, of more or less problematical value, which have been devised to explain the well-known process of fever. In view, however, of the paramount importance of the subject as essentially a practical one, the general notions on the subject, which prevail at the present time, will be here enumerated.

The *process of fever* presents the following phenomena:—

(1) There is increased tissue-destruction (oxidation or combustion).

(2) As a result of this there are the following changes:—

Physico-chemical.—(a) Increased production of heat; (b) increased production

of waste products; (c) degenerative changes in tissues.

Functional.—(d) Acceleration of heart-rate; (e) acceleration of breathing rate; (f) vaso-motor contraction and relaxation of arterioles, formation of rash, &c.; (g) increased secretion; (h) diminution of assimilative power; (i) clonic spasm (*see* RIGOR); (j) diminution of mental power and production of delirium.

The above familiar facts require no explanation or amplification, and it only remains to notice, in addition, the condition known as *hyperpyrexia*. This state, which to outward appearances is simply an exaggeration of ordinary physico-chemical change, shows itself symptomatically by a rapid rise in the temperature, and leads, unless adequately treated, to a fatal issue. Its causation is more obscure than that of simple fever, since it occurs under circumstances where, apparently, no change has been observed in the condition of the patient.

Etiology.—Little can be said of the etiology of the febrile process in general, seeing that it necessarily differs according to the exciting cause in each instance; but, as far as individual peculiarities go, it appears that age plays an important part in determining the intensity of the process to some extent. As might have been expected, the tendency to perversion of the balance between the production and regulation of heat is greatest at the time when the metabolic processes are most active; for this reason it gradually diminishes with age. It is uncertain whether sex and other conditions really influence the febrile process; but race does seem to cause a predisposition to it, especially where the causation can clearly be traced to changes in the nervous system.

Causation.—Fever may be caused by—(1) Lesions of the nervous system. *See* NEUROTIC FEVER. (2) Absorption of specific poisons called contagia. (3) Absorption of certain chemical substances.

At the present time (having regard to the alterations in the bodily functions produced by fever), it is generally believed that the above causes of fever act by influencing the central nervous system, so (a) increasing heat-production directly, or (b) removing inhibitory action over the degree of tissue-metabolism. This belief, which practically assumes the existence of heat-centres governing the production of heat by regulating both tissue-change and vascular capacity, is supported by many facts of clinical experience which need not be detailed here.

Symptomatology.—For any special points not enumerated in the list of symptoms of fever sketched above, the various articles on each variety of fever must be referred to.

Treatment and Prognosis.—The details of both treatment and prognosis of fever, as seen in surgical cases, will be found under the headings enumerated at the beginning of this article. VICTOR HORSLEY.

SURGICAL KIDNEY. *See* PYELO-NEPHRITIS.

SUSPENDED ANIMATION may be defined as a condition in which all the coarser manifestations of life are in abeyance; in which the patient is motionless and senseless, with arrested respiration, and scarcely any recognisable evidence of the heart's action.

An exhaustive treatise on the subject should include a discussion on the hibernation of animals, and those other conditions in which the arrest of animation consists mainly in the stoppage of the mental faculties, as is seen in coma, sleep, the mesmeric trance, and some forms of melancholia; but, in a practical work like the present, it is necessary to confine our attention to those forms of suspended animation which the surgeon is called upon to treat.

These are *two* in number—viz. *syncope* and *asphyxia*.

SYNCOPE, or fainting, is brought about by failure of the blood-supply to the brain. Such failure may be due to causes situate in the heart itself, as anæmia, or fatty degeneration of the cardiac muscle, or valvular disease; or the heart may fail from faulty or perverted innervation, brought about by causes acting through the mind (such as fear or the sight of blood), or through the body, such as an overcharged stomach or a sudden injury. These are examples of reflex action in which a peripheral irritation, whether bodily or psychical, causes inhibition of the vagus by acting through the centre of origin of that nerve.

Again, the causes of syncope may be, as it were, mechanical, and the blood may fail to reach the brain because its course has been diverted, either by hæmorrhage, whether external or internal, or by the dilatation of the abdominal vessels, as occurs in conditions of shock, and especially in sudden injuries to the abdomen. Usually the conditions which produce syncope are mixed.

The *symptoms* of syncope are giddiness and pallor; the face becomes pale, the fore-

head often beads with perspiration, and the patient, who is usually warned by a feeling of faintness, giddiness, or nausea, falls insensible. The pupils are often dilated, the pulse can scarcely be felt, or may for a few seconds be quite imperceptible, and the sounds of the heart are exceedingly weak. Recovery usually commences immediately, and as soon as the patient is laid horizontal there is a slow gasping inspiration, followed by a return of consciousness. When syncope proceeds to a fatal issue, the respiratory acts become very laboured, and death is usually preceded by a fit of convulsions.

The *treatment* of a fainting fit consists in keeping the patient horizontal, so as to favour the circulation through the brain and tax the strength of the heart in the least possible degree. Take care that the circulation and respiration are not impeded by any constricting bands round the neck or waist, and, if necessary, loosen the clothing at the neck and undo the stays. Admit fresh air in abundance, but, at the same time, take care that the patient is not chilled. Let him be covered with wraps and keep the feet warm. The respiration may be encouraged (and the circulation indirectly) by dashing cold water on the face and upper part of the chest, but the greatest care must be taken that the patient is not made unnecessarily wet, and that the damp clothing is dried as soon as possible. These measures are all that is required in an ordinary fainting fit, and, if the patient be left undisturbed for half an hour, recovery will be complete. It may be advisable to give some stimulant, and a small quantity of brandy or sal volatile mixed with water (hot water is best) will increase the vigour of the heart's action. If the faint be prolonged and the signs of recovery delayed, and if the patient cannot swallow, no time must be lost in giving a stimulating enema of an ounce of brandy, or in injecting ammonia hypodermically (twenty to thirty drops of Sp. Ammoniae Co.).

ASPHYXIA is a state of suspended animation, which is primarily due to a failure of the respiratory functions—i.e. the oxygenation of the hæmoglobin of the blood. This may be caused—

1. By the non-admission of a sufficient supply of oxygen to the lungs, or by the inhalation of a gas incapable of oxidising the hæmoglobin, such as carbonic acid, carbonic oxide, or sulphuretted hydrogen. This accident is usually brought about by the closure of the air-passages, as in strangling or throttling; or by the impaction

of foreign bodies in the larynx or trachea, or the compression of the trachea by foreign bodies in the œsophagus. The inhalation of gases unfit for respiration is an accident which happens to well-sinkers, brewers, sewer-men, night-men, and occurs in one form of suicide—viz. by the inhalation of charcoal fumes.

2. Asphyxia may be brought about by a failure of the respiratory apparatus. In fractures of the spine above the origin of the phrenic, the immediate cause of death is asphyxia. In poisoning with curara or strychnia, the respiratory muscles are rendered useless by paralysis or spasm, and asphyxia results. During the inhalation of chloroform, asphyxia is one of the dangers, caused apparently by the failure of the dilators of the glottis (the crico-arytænoidei postici) to contract in unison with the descent of the diaphragm. If both pleural cavities be opened, then the respiratory machine fails to work, and asphyxia results. Again, compression of the chest, as in crowds, or when persons are covered with falling earth, may lead to asphyxia.

3. The most common cause of asphyxia is drowning, in which water takes the place of air in the higher respiratory passages, and effectively prevents the oxygenation of the blood.

The term *asphyxia*, which literally means pulselessness, has been cavilled at as inappropriate, and the word *apnœa*, or breathlessness, has been proposed for the condition of suspended animation from respiratory failure. The latter term has, however, been used by physiologists to denote a condition of arrested respiration from the excess of oxygen in the blood, and has, therefore, been discarded in favour of its older rival.

The *symptoms* of the asphyxial condition may be shortly stated. At first there is great anxiety, and the want of oxygen in the blood and tissues causes great efforts to breathe, and, the respiratory centre in the medulla being over-stimulated by the venous blood, the extraordinary muscles of respiration come into play. Insensibility quickly supervenes and the skin becomes livid. The lips and finger-tips get distinctly blue, the conjunctivæ are injected. The eyes are bright and protruding, and the pupils usually large. Sometimes there are general convulsions. The pulse is at first quickened, and then fails.

The rationale of the asphyxial condition is said to be as follows:—The blood not receiving its supply of oxygen, and being unfitted for the needs of the tissues of the

body, the arterioles contract and prevent its circulation. The left cavities of the heart, the lungs, and the right cavities of the heart, are in turn and in the above order distended with blood, and ultimately the blood is, as it were, dammed back in the veins, while the arteries are empty, or nearly so.

It is usual, *post mortem*, to find the right cavities of the heart as well as the veins distended with dark blood, while the left cavities of the heart are empty. The explanation offered by physiologists of this fact is that the left cavities, originally distended, are emptied after death by rigor mortis.

The *treatment* of suspended animation from asphyxia consists—(1) in the removal of the cause; (2) in the stimulation of respiration, and (3) in the stimulation of the circulation. It seems needless to insist that the first measure is to pull the drowning man from the water, or to cut down the man found hanging. These necessary preliminaries having been accomplished, the first thing is to see that *the air-passages are free for the admission of air*. If any articles of clothing are constricting the neck or chest, these should be at once loosened and removed.

Next look to the mouth: pull forward the tongue with one hand, and pass the fingers of the other hand completely into the pharynx, so as to remove any foreign body which may have got there by accident or have been intentionally placed there, such as mud and weeds, a lump of food, false teeth, or possibly some kind of plug intentionally thrust into the pharynx by a determined suicide.

While this is being done the head should be turned to one side, so that fluid may flow out easily. Next, we have to empty the trachea and bronchi of fluid (in cases of drowning), and also to give an opportunity to any fluid which may have been swallowed to be ejected from the stomach. To this end, turn the body on its face, taking care that the trunk is higher than the mouth, and that the mouth is kept open and the tongue pulled well forward; and at the same time exert steady, firm pressure round the margin of the thorax and upper part of the abdomen, so as to assist in the mechanical expulsion of fluid from the lungs and stomach.

This should be done thoroughly and quickly, and the patient should then be turned upon his back, lying on the ground, or better, on a table of convenient height, if one be at hand. The head should be

raised on a small bolster, or a roll of clothing, or anything of suitable size and shape which may be available; the neck should be extended and the chin raised.

Artificial respiration should then be commenced by Silvester's method, which is performed as follows:—

The patient lying as above described, stand directly behind his head, seize the arms at the elbows and press them firmly and gently against the sides of the thorax. By this manœuvre some of the air in the lungs is expelled, and it is always well to begin with an expiratory movement. Next, pull the arms, gently but firmly, above the head as far as they will go; the removal of the pressure from the elastic thorax and the traction of the humero-thoracic, claviculo-thoracic, and scapulo-thoracic muscles on the ribs cause these latter to be raised and the capacity of the thorax to be increased, and, if the air-passages be free, air *must* flow into the lungs. It is usually easy to tell if the artificial respiration is efficient, for, with or without the aid of a stethoscope, the passage of air through the larynx and trachea can be heard.

It is important to bear in mind that artificial respiration is a purely mechanical act, and that, if efficiently performed, air must enter the lungs, even of a corpse which is hopelessly dead. It is not less important to remember that the efficient entry of air is no sign *per se* of returning vitality. Artificial respiration must not be performed too quickly or too violently. From twelve to sixteen respiratory actions per minute is sufficient. The pressure exerted by the patient's arms and elbows against the sides of the thorax must be firm, and the traction on the ribs effected by the arms, when pulled above the head, must be certain and steady.

Howard proposed another method of performing artificial respiration. The body is first laid prone with the head lower than the trunk, and with a roll of clothing placed beneath the stomach. Firm pressure is then made upon the spine, and in this way fluid is squeezed out of the stomach and lungs. The body is then laid supine, with a roll of clothing in the hollow of the back. An assistant holds the arms drawn above the head, and at the same time keeps the tongue pulled forward. The operator then kneels astride the body, placing the palms of the hands over the short ribs. He then, by alternately throwing the weight of his body on to the palms of his hands and then letting go, produces contraction and enlargement of the thoracic cavity. In this way, air effects an entry and exit from the

lungs, but the method is not so efficient as Silvester's. It is very important to take care not to break the patient's ribs, an accident which has followed excessive and unwise zeal on the part of the operator.

Of all methods of resuscitation, artificial respiration is the most important, and it must not be delayed or relaxed under any consideration. At the same time, it must be remembered that the circulation must be encouraged, and, while the operator is performing artificial respiration, he must give directions to the bystanders to proceed with other measures.

The wet clothing must be removed as best it may, and no hesitation must be thought of in the use of scissors or knife, as an aid to this process. The body must be rubbed dry, and with *warm* towels if possible. Warmth must be encouraged by hot blankets and bottles of hot water to the feet, between the thighs, and to the flanks. Steady friction of the limbs towards the trunk is also of service as an aid to circulation and as a help in restoring the animal heat, of which the patient has, mayhap, been deprived by long immersion.

Stimulants must also be administered. An ounce of brandy, with an equal amount of hot water, should be injected into the bowel, and stimulants should be administered by the mouth if the patient can swallow. The application of ammonia to the nose may be of service, as may also the hypodermic injection of half a drachm of the compound spirit of ammonia.

An electric battery may be of use, and if one is at hand it may be brought. The faradising or induced current must be used, and the object of its use is to cause a vigorous contraction of the diaphragm, and thus aid in respiration. This is not easy to bring about. The best way to proceed is to place one rheophore (well wetted with hot salt and water) on the side of the neck, over the phrenic, in the angle formed by the external border of the sterno-mastoid with the line of the omo-hyoid muscle. Make firm pressure with this rheophore, and when the arms are being raised above the head take the opportunity to place the second rheophore (which should be of large surface and well wetted with hot salt and water) over the sixth interspace in the right axillary line. If, in this way, a vigorous contraction of the diaphragm can be brought about, a far larger volume of air will enter the lungs than when Silvester's method is used alone.

Duchenne advises that in these cases faradisation should be employed for its re-

flex effects, and he recommends that the precordial region and also the back of the chest should be faradised with a wire brush, and he asserts that in this way he has restored circulation and respiration in those apparently dead from suffocation.

If the operator is satisfied that by the methods already recommended air is made to flow into and out of the lungs, well and good; but if he be not satisfied on this head, then, as a last resource, he may have recourse to tracheotomy. Possibly the opening of a jugular vein might allow of the escape of some blood, and thus relieve the over-distension of the right ventricle and encourage it to contract. These two last measures are not recommended as a matter of routine.

From whatever cause the asphyxia may have been produced, the efforts at resuscitation must be continued methodically and thoroughly for at least half an hour, and if the patient be revived, he must be carefully watched for some hours, as it is characteristic of some forms of asphyxia (especially from charcoal fumes) that the sufferer is liable to relapses, and may need the help of artificial respiration a second and even a third time.

In the case of new-born children who have never breathed, the chances of inducing vitality are far greater than in the case of patients whose respiratory functions have been suspended by asphyxia. In the case of the drowned, it is said that recovery is not possible after two minutes' complete immersion; but as the time of immersion can never be certainly ascertained, efforts at resuscitation should not be hastily abandoned.

G. V. POORE.

SUSPENSION.—Mechanical convenience and therapeutic benefit may be derived from the appropriate use of means to suspend the whole body, or parts of it. Having to remove (1862) at the hip-joint a lower limb weighing 99 lbs.—nearly two-thirds of the weight of the whole body—and measuring 48 inches in circumference, the writer suspended the limb. Two long towels passed round the enlargement, and joined in the middle line above, were attached, by a hook and double pulley, to a beam in the roof of the operating theatre. An assistant holding the pulley-rope, while standing well out of the way, was thus enabled to raise and lower the huge limb accurately and easily, greatly facilitating the whole operative procedure, which resulted in the patient's surviving for sixteen years.

Professor Annandale has since advocated, as an aid to surgical demonstrations and practice, the principle of suspension, which has been largely utilised by Professor Sayre in his treatment of spinal disease, by the suspending tripod and the plaster jacket. In arresting hæmorrhage, and treating injured and swollen parts, suspension is of great use and comfort. It is so especially when combined with immobility and equable pressure, by checking the inward and favouring the return blood-flow, relieving pain and promoting absorption and drainage, in direct proportion to its efficiency in lessening vascular and nerve tension. Swellings of the breast, scrotum, and limbs supply many illustrations in point.

Swings, whether with anterior or posterior splints or rods, are very useful; but it is important to bear in mind that suspension in a swing, to be effective, should be elevation and something more. A limb suspended to a bed-cradle by two or three loops of bandage, or leather straps, is certainly raised on an inclined plane, but not swung on the hammock principle. The suspending medium should be as movable as possible, so as to exhaust in its undulations the motive power communicated to the limb. In the case of a limb encased in an accurately fitting mould, and properly swung, undulation of the suspending medium conduces to immobility of the suspended part. In the absence of special instruments, an upper or a lower limb may be suspended, comfortably and efficiently, by very simple contrivances—e.g. fix the limb with a handkerchief, a towel, or a few turns of bandage, on a padded board, or in a wooden or wire frame; then swing this by cords attached to the angles, and gathered into one and suspended by a hook from the bed-head or the ceiling. The effect is harmonious co-operation of apparently very dissimilar mechanical agencies, fixity and mobility in securing perfect rest, preventing irritation, congestion, and their sequelæ, and, in direct measure, favouring physiological repair. *See* IMMOBILITY; POSITION; PRESSURE; REST. SAMPSON GAMGEE.

SUSPENSORY BANDAGES are employed to support the scrotum and testicles in cases of varicocele, hydrocele, epididymitis and orchitis, and to support irreducible scrotal herniæ.

Special bandages, of which there are many varieties, may be obtained for these purposes from instrument-makers, but very efficient ones may be devised by the surgeon with handkerchiefs or a piece of strapping.

The handkerchief should be folded into a band and tied round the pelvis; another should be folded three-corner ways, so as to make a triangular bandage. The middle of the base of the second should then be placed behind the scrotum, and the two ends should be looped over the pelvic girdle from before backwards; the apex of the bandage should be turned up and looped over the pelvic band in front, from behind forwards, and pinned to it. The two ends should be finally brought round and tied in front of the pubes. If the patient be confined to bed, the scrotum may be supported on a band of strapping, which is fixed to the front of the two thighs, so as to form a shelf across the interval between them.

Of the special bandages, the simplest consists of a bag made of silk or cotton netting, suspended from a pelvic band; there is a large opening at the posterior part of the bag, through which the scrotum can be introduced into it, and there is a smaller opening in front for the penis. In some of the suspenders, the size of the bag may be lessened and its base raised, by tightening a running tape placed in the margin of the hole for the penis. In others the bag is buttoned to the front of the pelvic girdle, and can be raised up or lowered, as desired, by fastening it to a higher or lower button on the pelvic band. When the bag is well braced up so as to form an efficient support, the scrotum is pulled forwards and a visible protrusion beneath the trowsers results, and the scrotum is liable to slip out of the bag. To prevent this, two perineal straps may be attached to the posterior margin of the suspender, carried backwards between the legs, and fixed to the pelvic band behind the body.

Keetley's suspensory bandage differs from that above described, in having no aperture for the penis, in the tape round the margin of the suspender being replaced by an india-rubber ring, and in having a median perineal band provided with an india-rubber ring opposite the anus; the ring is intended to prevent chafing of the anus and soiling of the perineal band.

Morgan's suspensory bandage for varicocele consists of a piece of webbing about $4\frac{1}{2}$ inches long, 6 inches broad at one end, and $3\frac{1}{2}$ inches broad at the other; a piece of leaden wire is fixed in the hem at the smaller end, and the long borders are perforated with a series of holes. To apply the apparatus, the piece of webbing should be wrapped round the scrotum and the

affected testicle, the piece of wire being bent so as to form a ring above the testicle; the long borders of the webbing should be laced together so as to envelop the testicle within it. By means of two straps, which are attached to the apparatus, the testicle may be raised up and suspended from a pelvic band; when raised up, the border of the apparatus which contains the leaden ring will be lowest, and upon it the testicle will chiefly rest.

Williams's suspender consists of a triangular piece of netting; one corner of it should be fixed between the legs by a perineal strap, and the base should be raised upwards and fixed to a pelvic band. The effect of this apparatus is to support the genitalia against the lower part of the abdomen.

To support irreducible scrotal herniæ, a strong bag made of jean, and lined with washleather, is used; it may be suspended entirely from the shoulders, or part of the weight may be borne by a pelvic band.

BILTON POLLARD.

SUTURES or stitches are employed to hold the cut surfaces of wounds in accurate apposition during the process of healing. The materials in common use for sutures are silver wire, silver-plated copper wire, soft iron wire, dentist's silk, silkworm-gut, catgut, and horsehair. The metal sutures, silkworm-gut, and horsehair are non-absorbent, and one or other of them should be chosen when means are not taken to prevent putrefaction of the discharges from the wound; an absorbent substance, like silk, would become saturated by the chemical products of putrefaction, and cause irritation, and probably suppuration, along its track. If, however, some form of antiseptic treatment of the wound be adopted, any of the above-mentioned substances may be used for sutures. Silk which has been well soaked for twenty-four hours in a solution of carbolic acid (1 in 20) is as good as any for general use. Catgut has the advantage that, in suitable cases, the deep part of the suture is absorbed and the superficial part is left free in the dressing; carbolised catgut is usually absorbed in four or five days, but the chromicised gut resists absorption for a much longer time. Horsehair makes a very good suture for wounds in which very little strain is thrown upon the stitches.

The soft sutures, such as silk, catgut, or horsehair, may be introduced by any form of needle either straight or curved, but the needle in common use, which is flattened

transversely towards the point, is open to the objection that it makes an incision parallel to the direction of the wound; so that, when the suture is tied, the needle-puncture is drawn into a triangular wound, which does not always heal by first intention. Hagedorn's needle, which is flattened in the opposite direction, makes an incision at right angles to the direction of the wound, and consequently in the line of traction of the suture. For the introduction of wire sutures, some special modification of the eye is needed, so that the loop by which the wire is linked to the needle be not too bulky to be drawn through the needle-puncture. Price's two-eyed needle is one of the best for this purpose, though it is open to the objections above alluded to. *See* NEEDLES.

Sutures may be introduced in many ways: the more important of these will now be considered.

The *interrupted suture* is the simplest. It consists of separate stitches, passed obliquely from without inwards through one side of the wound, and made to emerge in a similar manner from within outwards on the other; each stitch should be tied in a reef knot, and the knot should be drawn to one side of the wound. The sutures should be drawn just sufficiently tightly to bring the edges of the wound into accurate apposition, without constricting the tissues included in the loop. In tying horse-hair or silkworm-gut sutures, the surgeon's knot, in which the first half-knot consists of a double loop, is preferable to the reef knot, because the smooth surface and resiliency of these sutures allows very slight tension to loosen the first half-knot of the reef knot, before it can be fixed by the second.

To close a longitudinal wound, the first suture should be placed in the middle, the second and third on either side of this, between it and the end of the wound, and so on until the wound is sufficiently closed. In angular wounds, or wounds of still more complicated shapes, the retracted angles of skin should be, first of all, fixed in position. Wire sutures may be fastened either by twisting the ends together, or by linking them together as in a half-knot and then turning the ends sharply upwards, so as to prevent the link slipping. The latter method is preferable for stout wires, as the process of twisting them is liable to displace the edges of the wound, which have been previously adjusted.

When a large surface of skin has been removed, as frequently happens in the excision of malignant tumours, the tension of the flaps on the sutures is liable to cause

irritation and inflammation at the margins of the wound, and in that way interfere with their union. In order to obviate this, deep sutures of stout wire or silk may be introduced about an inch from the margin of the wound, and drawn sufficiently tightly to allow of the skin coming together without any strain on the superficial or adjusting sutures. The deep sutures here referred to are often spoken of as *sutures of relaxation*. They should be removed on the second or third day.

In removing sutures, care must be taken that the union of the wound is not disturbed thereby. Silk or other soft sutures should be raised with a pair of forceps and snipped on one side close to the skin, and withdrawn by pulling the knot gently towards the side on which the suture was divided, so that the tendency of the traction is to bring the edges of the wound together rather than otherwise. A wire suture should be divided on one side of the twist or link, and straightened out as much as possible with two pairs of forceps before it is withdrawn.

Continuous Suture.—Under this name two different forms of suture are often included: one is the stitch of the seamstress, in which the thread passes from without inwards through one lip of the wound, and from within outwards through the other; the other is the glover's stitch or the herring-bone stitch, in which the thread passes from within outwards through both lips of the wound. The former is the true continuous suture, and the one usually meant by the term. It is recommended for cases where very accurate apposition of the edges of the wound is desired. It used, at one time, to be almost the only suture employed for stitching up wounds of the intestines, and it has latterly been recommended for that purpose. It is not a very safe suture, because, if one loop cuts out, the others are liable to become slackened.

The *fold suture*, or suture of Bertrandi, is another form of continuous suture. It is recommended in cases where the skin is very thin, and where, in consequence, the margin is liable to become inverted. It is commenced as an interrupted suture, but, instead of the thread being cut, the needle is passed back again through the lips of the wound, in a similar manner, a little farther on, and so on alternately; so that the loops do not lie across the wound, but alternately on one side and the other, as in the darning stitch of the seamstress. The result of this is that adjacent parts of the deep surface of the skin are brought into apposition, and the tendency to inversion is overcome.

In removing a continuous suture, the surgeon should never attempt to draw the whole thread out together, for in doing that there would be much risk of tearing the wound open, or of tightening up some of the loops, instead of withdrawing the suture; each loop should be divided and removed like an interrupted suture.

The *figure-of-eight* or *twisted* suture is frequently used in plastic operations about the face, and especially in cases of hare-lip. In applying the suture to a wound passing completely through the lip, a long needle should be entered about three quarters of an inch from the margin of the wound and made to emerge on the cut surface close to the mucous membrane, without, however, perforating the latter; it should then be made to perforate the other lip of the wound in a similar manner, though of course in the opposite direction. A piece of silk should then be twisted in figure-of-eight loops round the needle, so as to draw the margins of the wound into apposition without causing much compression of them. If a second needle is required, it should be placed in position before the silk is applied to the first. The points of the needles should be cut off, and a piece of plaster placed beneath the ends so as to protect the skin. The needles should be withdrawn by a gentle rotatory movement in from thirty-six to forty-eight hours, but the pad of silk should not be disturbed until it gets loose. Interrupted sutures should be inserted here and there, to bring the skin and mucous margins into apposition.

The *button suture* is a suture of relaxation, which is very useful when much skin has been removed and a widely gaping wound has to be closed. The buttons are oval pieces of sheet-lead, measuring from three-quarters of an inch to an inch and a half in the long axis, having a small hole in the centre and a wing projecting from each long side of the oval. The free end of a stout piece of silver wire, threaded on a needle, is passed through the hole in the button and secured by twisting it round the projecting wings. In applying the suture, the needle, carrying the wire with the button attached, is entered an inch or more from the cut edge, and brought out at a similar distance from it on the other side. The needle is next passed through the hole in a second button, and the latter is pressed firmly up to the skin until the edges of the wound are brought sufficiently close together; the wire is then twisted round the wings of the second button so as to secure

the suture in position. It is the best suture of relaxation, for the strain is widely distributed by the buttons, and so there is less likelihood of the wire cutting out quickly. Fine interrupted sutures will be required as well, but the greater part of the strain will be borne by the button sutures. Button sutures should, as a rule, be removed by the third day. Their removal is easily managed by cutting the wire between the skin and one button, and pulling gently on the other.

The *quilled suture* is used to bring the deep parts of a wound into apposition, as well as to take off the strain from the superficial sutures. It is most used for plastic operations on the female perineum. For its application, a needle with an eye at one extremity should be threaded with a loop of wire, entered about an inch from the margin of the wound, carried deeply down, and finally made to emerge in a similar manner and at a corresponding point on the other side. The needle must next be withdrawn, and the wire left *in situ*. As many sutures as are required should be passed in the same way. There will then be a loop projecting from each needle-puncture in one lip of the wound, and two strands of wire through each puncture in the other. A quill or piece of bougie should next be passed through each loop, and the quill and loops should then be pulled firmly against the skin. Another quill should be placed on the other side of the wound, parallel with the first, in such a manner that one of the wires of each suture lies over it and the other beneath it, and then the corresponding wires should be twisted together over the second quill with sufficient firmness to bring the lips of the wound into apposition. Superficial adjusting sutures should also be employed.

Various special sutures are employed for *enterorrhaphy*—that is, the closure of wounds of the intestines, or the union of two ends of gut after a resection operation has been practised. They all aim at bringing the serous surfaces of the gut into accurate apposition, for the very rapid adhesion which takes place between them entirely prevents extravasation of the intestinal contents; some aim at bringing the mucous surfaces into apposition as well.

Lembert's suture brings the serous surfaces together without perforating the mucous lining of the gut. The needle is entered on the serous surface, about a quarter of an inch from the margin of the wound, and dipped through the muscular and submucous coats, being made to emerge

on the same side of the wound about one-sixth of an inch from the margin, without perforating the mucous membrane. The needle is next passed in a similar manner through the tissues on the other side of the wound, entering the gut on the serous surface about one-sixth of an inch from the margin, and emerging about one-quarter of an inch from it. As many sutures as are needed are inserted about one line apart, and then they are tightened up, one after the other, and tied in reef knots. It has been urged against this suture that its hold on the intestinal walls is so slight that it is liable to give way, and that, owing to its not perforating the mucous coat, its detachment into the lumen of the gut will be impeded. The latter objection would be met by the use of catgut sutures.

The *Czerny-Lembert suture* differs from the last in the addition of a second row of sutures, which are made to unite the mucous membrane only, just at the cut margins. The advantages claimed for it are that it affords greater security, and also prevents leakage of intestinal contents between the serous surfaces which are adjusted by Lembert's suture.

Gussenbauer's suture is intended to accomplish the same objects as the last with one stitch, which is commenced, like Lembert's, on one side of the wound, but, before it is finished on the other, it is made to pick up the mucous membrane first on one side and then on the other side of the wound, so that, when the suture is tightened up, the deep surfaces of the mucous coat are brought into contact as well as the serous surfaces of the gut.

Jobert's suture. — In the stomach, where the coats are thicker, Lembert's suture may be easily applied, but in the small intestine there is more difficulty on account of the thinness of the muscular coat, and, in order to obtain a more secure hold on the intestinal walls, Jobert recommends that the suture should not avoid the mucous membrane, but should be carried through the whole thickness of the gut. In other respects this resembles Lembert's suture. In cases of complete transverse division of the gut, Jobert recommends the following method of suture: The surgeon first passes a suture, armed with a needle at each end, through the upper extremity of the divided intestine, at about two-thirds of an inch from its margin. The lips of the lower portion of the divided gut are then inverted, so that the serous lining of the reflected portion looks towards the lumen of the gut. This inverted portion is

held in position between the finger and thumb of the left hand, whilst with the right the needles attached to the suture, already inserted in the upper portion, are passed through the double thickness of gut from within outwards; the outer needle is first passed close to the folded border, and the inner one about two-thirds of an inch lower down. A similar suture is passed at the other side of the gut, and then, by pulling at the four ends of the sutures, the upper portion of gut is drawn within the inverted lower portion, so that two serous surfaces are brought into apposition. The two ends of each suture are then tied together. Additional security may be obtained, by inserting a series of Lembert's sutures in the angle where the serous surfaces of the two segments of gut come together.

Gély's suture is recommended by its inventor either for closing linear wounds, or for uniting the gut after complete transverse division. It is a continuous suture. The thread is armed with a needle at each end. One of the needles is entered just behind the wound and about one-sixth of an inch from its margin, and, after traversing the lumen of the gut parallel to the direction of the wound, it is brought out about one-sixth of an inch from its point of entry. A similar stitch is made on the opposite side of the wound with the other needle. The sutures are next crossed over one another and over the wound, and each needle is entered at the puncture from which its fellow has just emerged, and is ready to repeat the stitch. When as many stitches have been introduced as is necessary to unite the wound, the thread is tightened up by pulling on the successive transverse loops, and the ends of the suture on either side of the wound are tied together. This method causes inversion of the edges of the wound, and brings the serous surfaces into accurate apposition.

Emmert's Suture.—The needle is entered on the serous surface of the intestine about one-third of an inch from the margin of the wound, dipped through the serous and muscular coats of the gut transversely to its axis, and brought out about one-sixth of an inch from the margin. The needle is next carried parallel to the direction of the wound, and entered on the serous surface of the gut about one-third of an inch beyond its last puncture, and made to traverse the walls of the gut at right angles to the direction of the wound and emerge about one-third of an inch from its margin. A fellow-stitch should be placed in the other lip of the wound, and as many couples should

follow as are required to close the wound. The corresponding threads on opposite sides of the wound should be tied together, and the serous surfaces inverted and brought into apposition thereby.

Stanmore Bishop has recently described a suture for enterorrhaphy (*Medical Chronicle*, September 1885) which, though it is an interrupted suture, has the advantages of a continuous one; the knots are all within the lumen of the gut, and the loops are so placed that, when loose, they also may readily drop into it. Bishop has found by experiments on animals that, after the employment of this suture, 'no sign of ridge or suture, but a plain mucous surface, with no trace of the previous division,' may result. He uses a small round straight needle, threaded with fine Chinese twist or silk. The needle is placed exactly in the centre of the thread, which, when double, should be about 80 cms. (32 in.) long. 'The edges of the two pieces of divided intestine being approximated, a portion of both is seized by the forceps and turned inwards towards the lumen of the gut, in such a way that the serous surfaces of both are placed opposite and parallel to one another; and near the retiring angle, at the base of the fold thus formed, a needle carrying a double thread is thrust, from the mucous surface of the right side, through what has not retracted of the muscular coat, and through the serous coat of that side, and then through the serous, muscular, and mucous coats of the other side; the double thread is then drawn through until 6 cms. remain on the right side. One of the threads on the left side is to be cut 6 cms. long; the needle is then passed from left to right through the same fold, at a distance of 20 mm. from the first puncture. Two free ends and a loop remain on the left side, and two ends free and two connected with the needle on the right. By gently drawing upon the loop (on the left side), one of each of the two last pairs is seen to move; these are then drawn up so as to bury the loop in the mucous membrane on the left side and are reef-knotted on the right; the two ends are then cut off close to the knot. The free thread left in the first puncture is now drawn under the free extremities of the upper bars of the clamp, so as to be out of the way, and is reserved for the latter part of the operation. The needle is now carried back again from right to left through the base of the fold, and a similar loop is thus formed, this time on the right, and knotted on the left. In this way, as the suture progresses, a series of loops con-

sisting each of a single thread tied alternately on the right and left sides is formed, the threads of each loop passing through the same punctures as those of its neighbours on each side. When half the circumference of the bowel is united, and having finished the floor, so to speak,' Mr. Bishop prefers 'to take a fresh needle and thread; and tying one end to one of the free ends of the first thread, which it will be remembered was left behind, to commence again from the mesenteric border, and begin the roof from that point.' Thus the operator works towards himself whilst stitching both the floor and roof. 'In drawing up the loop which is thus formed, care must be taken to bring the knot in its centre directly opposite the middle of the portion of wall included.'

'On finishing the floor, too, a free thread will always be left; this is taken advantage of in finishing the entire suture, for the last loop is made by tying the two free ends on one side together; the loop thus formed is then drawn up on the other side, folding in the serous coats of both sides, and, the knot being made, the two threads are cut off close, the bowel becoming absolutely closed.'

BILTON POLLARD.

SWEATING FEET.—This offensive affection is not uncommon in young persons of both sexes, especially in those employed in in-door service, the subjects of it being often incapacitated from retaining their situations. The general health is usually not good, the circulation feeble, and the appetite often disordered.

Treatment.—The feet should be well bathed in salt and water two or three times a day, rubbed and dried most thoroughly, especially between the toes, and these parts well dusted with zinc and starch powder, to which a little iodoform powder has been added. Boots or shoes, socks or stockings, should be changed frequently; anything in the nature of patent leather is to be forbidden, and shoes preferred to boots, as admitting of better ventilation and more frequent changing. Belladonna liniment, as recommended by Dr. Ringer (the liniment being made up with eau de cologne, if preferred), may be employed; or the treatment recommended by Professor Hebra made use of. Here, an ointment made of equal parts of lead ointment and linseed oil, spread on linen, is wrapped round the feet, the application being renewed every third day for nine days. The practitioner, in using the above, must be prepared for its causing irritation in some cases, and even the outbreak of a papular eruption.

Improvement of the general health is nearly always required, it being needful to insist on sufficient open-air exercise, bathing, and attention to the appetite and bowels. See BROMIDROSIS.

W. H. A. JACOBSON.

SYCOSIS.—*Synon.* Sycosis non-parasitica, Mentagra.

Definition.—A chronic inflammatory disease affecting the hairy parts of the body (chiefly the face in the male sex), and characterised by the development of pustules pierced by hairs.

Cause.—This has not yet been ascertained; various diathetic conditions were formerly thought to give rise to it, e.g. rheumatism, gout, struma. According to later investigations, it is probably due to the irritation of the growing stiff hair on the walls of the follicle, in an individual out of health, or on a part predisposed to inflammation by the presence of some superficial dermatitis (eczema). Shaving, especially with irritating soap, and exposure to heat or cold, are also thought to be instrumental in causing the disease.

Pathology.—The affection is primarily a peri-folliculitis, the fibrous sheath of the hair-follicle being first invaded by inflammatory products (serum and pus). Soon the root-sheaths become involved, and the base of the follicle, the papilla resisting to the last; the hair-coverings (root-sheaths) as well as the soft structure of the hair itself, undergo destructive change, the hair falls out and is not reproduced if the papilla has been destroyed; not infrequently the neighbouring structures, the sebaceous and sweat glands, and even some portion of the skin itself, are involved in the destructive process, leading to loss of substance and scarring.

Symptoms.—In a simple uncomplicated case, at the commencement of the disease, there are seen a few papules pierced by hairs, accompanied by some temporary heat and swelling of the part affected, usually the chin. The papules may be isolated, but they tend rather to be aggregated together in groups. Soon each papule becomes surmounted by a minute collection of pus, the papule becomes converted into a pustule, if the lesions are close together the infiltrations surrounding each join up and become confluent, so that the affected patch takes the form of one large dusky-red infiltration dotted over with points of pus, pierced by hairs; it was probably this appearance which was likened to the inside of a fig and suggested

the name Sycosis (*συκον*, a fig). The pustules may dry up into little round crusts, or, as happens more frequently, they discharge and lead to the formation of thick yellowish-brown crusts of dried inspissated pus. The hairs over the affected surface are either matted down, or stick up through the crusts. On removing the latter, those hairs which are loose in their follicles come away; a few remain behind in the dilated funnel-shaped mouths of the follicles. Occasionally, on removing the crusts from an infiltrated patch, the surface is seen beneath denuded of epidermis, granular, and bathed with pus (*caro luxurians*) calling to mind the appearances of condyloma. More deeply seated and extensive suppuration may occur, leading to the formation of small subcutaneous abscesses. The disease progresses by separate outbreaks such as has been described. Chronic cases are liable to be complicated by (a) the occurrence of a permanent, diffuse, erythematous-squamous, superficial dermatitis, affecting perhaps the entire beard or whisker region, the result of previous attacks; or by (b) more or less scarring and alopecia from former destructive suppuration.

Diagnosis.—This lies between sycosis parasitica, eczema impetiginodes, lupus, and syphilis.

Sycosis parasitica.—The early, red, itchy patches frequently round and multiple (tinea circinata), the continuous outbreak of pustules, the gnawed stubbly look of the hairs, their opaque white appearance and rottenness, the history of contagion and rapid development of the disease—finally, the presence of fungus as seen under the microscope, are the points determining the diagnosis.

In eczema the eruption is not limited to the hairy parts, but it must be remembered that eczema may be present with sycosis, having either preceded it, in which case it may be looked upon as having caused the sycosis, or it may have supervened, as explained above.

In eczema impetiginodes, its rapid development, appearance elsewhere, the abundant discharge, the large flat pustules not pierced by hairs, the non-occurrence of alopecia or scarring, will help the diagnosis.

Lupus vulgaris generally occurs before puberty, and is very chronic, the tubercles are not pierced by hairs, the nose or its neighbourhood has probably been previously attacked; loss of substance and scarring invariably accompany lupus.

In syphilis the papules or tubercles (copper-coloured), tend to be arranged in rings or segments of circles, they are painless and not pierced by hairs; concomitant symptoms are usually present—scars, gummata, &c.

Treatment.—This is mainly local. The hair should be cut short with scissors to within one-third of an inch of the affected surface. All crusts must be removed before any remedies are applied. This may be done by saturating them with warm oil or some simple ointment, then poulticing with linseed meal; if they are still matted down by the hair, they should be slightly raised and the hairs snipped beneath them, the part should then be bathed clean with warm water.

As long as irritation is present (heat, swelling, &c.) only soothing applications should be used, e.g. :—

R Pulv. zinci oxidi ʒvj.
Liq. plumbi diacet. dil. . . fʒvj.
ft. lot.

or Linimentum calcis. These remedies should be frequently and thoroughly applied to the affected parts.

Pus must be removed as soon as possible; small abscesses should be opened, and, above all, the hairs must be pulled out from the pustules. Each hair is to be grasped with epilation-forceps, and steady traction made in the direction in which it is growing; the hairs protruding from pustules will generally be found loose in their follicles, coming away without pain. By this procedure the pus is provided with an outlet, and the best chance afforded of avoiding destruction of the papilla. Some desiccant, soothing ointment should now be used night and morning, applied on linen and bound to the part. Hebra's ung. diachyli, ung. zinci benzoati, or ung. plumbi carb., are suitable ointments. If there is much infiltration the occasional use, once in two or three days, of some mercurial preparation will be necessary, such, for instance, as hydrarg. oleat. 5 p.c., or ung. hyd. ammon., mitigated by the addition of an equal quantity of ung. zinci. Opinions are divided as to the advisability of shaving the part; but the disease may be cured without resorting to this painful procedure of doubtful benefit. The patient should abstain from anything which may promote the disease—exposure to dust, heat, &c. Finally, constitutional treatment must not be neglected. The diet should be enquired into and regulated as to the quantity and quality of both food and drink. Dyspepsia, if present, must be treated, as well as any diathetic condition

(especially struma), on general principles. It is probable that nearly all cases will benefit by judicious regular purgation.

SYCOSIS PARASITICA.—Synon. : *Tinea barbæ*, ringworm of the beard.—An inflammation of the hairy parts of the face and neck, set up by the presence of the fungus of ringworm (*trichophyton tonsurans*).

Symptoms.—The disease generally shows itself at first as a small, sharply defined, round red patch, not raised above the surface. Not infrequently several such patches are present—the eruption soon becomes marginate, or exhibits signs of papulation and desquamation. Considerable infiltration with suppuration may early disclose itself, or indeed be present from the commencement, so that the disease puts on a scattered, pustular appearance, the surface being studded with crusted elevations pierced with stumps of hairs. Itching is complained of. The disease advances steadily, not by successive outbreaks. Changes in the hairs of the part affected are soon noticeable; if the beard or whisker is grown, there is partial baldness, the hairs have a gnawed, stubbly look, some are reduced to mere stumps, and have a peculiar, opaque, whitish appearance, like the stumps seen in *tinea tonsurans*. By pulling them slightly with the epilation-forceps, they break off close to the mouth of the follicle. On placing such stumps, or any other affected hairs, on a slide with a little liquor potassæ, and examining under the microscope with a high power ($\frac{1}{4}$ inch), the hairs are seen to be infiltrated with fungus-spores arranged together in chains, for the most part lying in the direction of the hair-fibres. These hair changes are of course most noticeable in cases where the beard or whisker is worn, but even when the patient has shaved, the white stumps may be recognised with a magnifying glass, just protruding from the follicles; they may be collected by scraping with a knife which has been dipped in liquor potassæ, and submitted to microscopical examination.

Diagnosis.—The disease may be confounded with—1. True sycosis (*sycosis non-parasitica*); 2. Eczema; 3. Syphilis. In all doubtful cases the microscope should be appealed to; if the fungus is found, it at once settles the question. The following peculiarities belong to *tinea*.

1. Early round or ringed patches; 2. Continuous and comparatively rapid development; 3. Absence of scarring or other signs of previous attack; 4. History of contagion (barber's razors, &c.); 5. Probable

existence of patches of ringworm on other parts of the body; 6. Partial baldness with stubbly appearance of hair, whitish brittle stumps, &c.

Treatment.—All pus-crusts must be removed, and if much irritation is present, this must be allayed before antiparasitic remedies are used (*see Sycosis non-parasitica, treatment*). The antiparasitic measures include all those which are adopted for the treatment of ringworm of the scalp. Of all the mercurial and tar preparations, perhaps the best are oleate of mercury and carbolic acid; the former should be used of the strength 5 p.c., at least at first; it should be freely rubbed in once every twenty-four hours, or more frequently if the skin can tolerate it. Should much irritation occur, the remedy should be discontinued for a day or two until the part recovers itself.

The glycerine of carbolic acid may be used in a similar way. The pharmacopœial Ung. hyd. nit., or Ung. sulph., are also useful remedies. Such applications necessarily set up a certain amount of inflammation, but they are especially liable to do so in cases where the disease has displayed a marked inflammatory type from the commencement. Success depends on the persistent use of efficient parasiticides, short of producing unmanageable inflammation. Epilation should be adopted, but it cannot be relied on to cure the disease.

ALFRED SANGSTER.

SYMBLEPHARON. *See EYELIDS, Diseases of the.*

SYME'S AMPUTATION OF THE FOOT. *See ANKLE-JOINT, Amputation at the.*

SYME'S OPERATION. *See TONGUE, Operations for Removal of the.*

SYMPATHETIC OPHTHALMITIS is a plastic inflammation of one eye, excited by some special irritation in the other. There are two forms of this disease: the first form, being the slighter, is called Sympathetic Irritation; the second is the severe affection now so well known as Sympathetic Ophthalmia.

1. **SYMPATHETIC IRRITATION** is probably only the early stage of sympathetic ophthalmia, as it will develop into it and is excited by the same causes. Sympathetic irritation is secondary to some excitant in the other eye, which is usually of an inflammatory character. The attacks are difficult to arrest, and they are very recurrent so long as the excitant in the other eye continues.

The points in which sympathetic irritation differs from sympathetic ophthalmia are:—1. Although the eye may be liable to frequent recurrences of the irritation, yet no fibrinous effusions nor disorganising changes take place in the tissues of the eye. 2. The excision of the injured or the diseased eye will, as a rule, at once arrest the irritation; whereas, in sympathetic ophthalmia, the excision of the other eye will but rarely exert any marked influence in controlling the disease.

The symptoms of sympathetic irritation are attacks of irritability of the sound eye, whenever the lost or injured eye becomes inflamed or painful; and, in some cases, whenever the sound eye attempts any prolonged effort of accommodation, without any change of appearance or altered sensation in the injured eye, and this is especially noticeable in eyes in which a foreign body is lodged. The symptoms are very variable: in some patients a slight indistinctness of vision is complained of, an inability to define clearly, and reading tires the eye. The patient may be able to read No. 1 of Jaeger's test types and to see distant objects rightly, but he cannot do so for any length of time, as the effort of accommodation fails, and the eye becomes fagged. In others, the eye becomes reddened and irritable whenever an attempt is made to use it, and occasionally it is painful; the seat of pain being sometimes referred to a position in the sound eye corresponding to the seat of injury in the other eye. Occasionally, there are neuralgic shooting pains in the sound eye, and this may be the symptom which gives the patient the greatest concern. Another symptom of which patients have frequently complained is that 'things dazzle in front of the sound eye, like heat over a stove.' There is frequently also some slight intolerance of light; the patient feels that the bright light of a clear day or bright artificial light is unpleasant. The symptoms of irritation are not always constant. In some cases there are attacks of irritation, which come on only when the lost or injured eye becomes inflamed, and subside when the inflammation has passed away; whilst in others the sense of there being something wrong with the sound eye, from the occurrence of some of the symptoms described, is ever present.

The *treatment* of sympathetic irritation undoubtedly is to excise the lost or injured eye, the source of the irritation, as with our present knowledge we cannot say when sympathetic irritation will drift into

sympathetic ophthalmia. If the injured or diseased eye be excised when there are symptoms only of irritation, and before the spotty deposits on the inner surface of the cornea have been developed, then we generally succeed in arresting the disease. The writer has known cases in which the attacks of irritation have continued to recur, at short intervals, for over twelve months, and yet, after the diseased or injured eye has been removed, the irritation has been completely arrested.

The palliative treatment consists in giving rest to the eyes by abstaining from work, by excluding the eyes from strong light by means of dark glasses, and by keeping the light in the living room subdued by dark blinds. As a local application, a weak solution of atropine, about gr. j. to the ounce of water, and internally small doses of the extract of belladonna, from gr. $\frac{1}{10}$ to gr. $\frac{1}{8}$ combined with quinine, are the most useful medicine.

2. SYMPATHETIC OPHTHALMIA differs from all other inflammations of the eye, both in the cause which produces it and in the character and course of the inflammation.

a. It is always due to some exciting cause in the other eye, and these may be thus briefly classed:—

Wounds of the eye, and especially those which involve the ciliary region; and wounds in and near the margin of the cornea, in which there is an entanglement of iris.

The lodgment of foreign bodies within the globe.

The irritation excited by degenerative changes taking place in eyes already lost either by injury or disease.

There are other causes which also give rise to sympathetic ophthalmia, but which may be regarded as exceptional. The operation for the extraction of cataract undoubtedly produces a certain percentage of sympathetic ophthalmia, but these unfortunate cases are, probably, far less numerous now than they were ten or fifteen years ago. About that date, it was the custom with many to carry the section through the sclerotic a little behind the corneo-sclerotic junction, and as the result to get frequently an entanglement of the iris in the edges of the wound. Experience has since proved that, by keeping the section corneal, we have less tendency to involvement of iris in the wound, and consequently many fewer cases of sympathetic ophthalmia following our cataract operations.

In the *Royal London Ophthalmic Hospital Reports*, vol. vi., Mr. Hulke has

recorded the case of a cyst of the iris which followed a penetrating wound with a fork. There was a serous iritis in the eye which had the cyst, and in the other there was sympathetic irritation. It was on account of the irritation in the uninjured eye that the mother brought the boy from Faversham to the hospital. Mr. Hulke removed the cyst through an opening at the margin of the cornea. The report states: 'The wound healed directly, and the iritis and sympathetic irritation of the other eye disappeared.'

It is a noteworthy fact that sympathetic ophthalmia is seldom, if ever, produced by a suppurative inflammation of the other eye. This fact was noticed by the late Von Graefe, and the writer's experience accords with it. If, however, there is a foreign body within the globe, suppuration of the eye does not diminish the danger which its presence in the stump may keep up.

β. *The character of sympathetic inflammation of the eye* is peculiar. It is essentially an adhesive or fibrinous inflammation. The tendency of the inflammation is to rapid, plastic effusions, which soon become organised and incapable of absorption, blending the tissues together and destroying their functions. As a rule, the eye is attacked without having pain as a warning. Children are frequently brought with the disease advanced into its second stage, and with the sight greatly impaired, because the absence of pain made the parents regard the affection lightly.

When once started, sympathetic ophthalmia is very difficult to arrest, and if, under treatment, it is subdued, it is generally only for a time, for the disease is very recurrent. The peculiar tendency of sympathetic inflammation to cause rapid effusion of lymph is manifested from the very commencement of the disease. In the earliest stage, there are usually spotty deposits of lymph on the inner surface of the cornea; then follows a plastic inflammation of the iris, which binds the pupil by adhesions to the anterior capsule of the lens, and rapidly extends to the ciliary processes, the choroid, and the vitreous. The lymph is not deposited on the surface in nodules, as in syphilitic iritis, but it occurs as an infiltration invading the very texture of the iris, ciliary processes, and choroid. In the synechiæ which are formed, it is not simply the pupillary margin, but the whole posterior surface of the iris which contracts adhesions to the capsule of the lens; so that if, at a future period, an attempt be made to form an artificial pupil by tearing

away a portion of the iris, the exposed part of the lens will be found covered with uvea, indicating exactly the extent of the adhesions which had existed between it and the posterior surface of the iris. Early in the disease, when the iris is saturated with lymph, it is soft and rotten; but at a later date, when all the acute symptoms have passed away, the iris has become completely changed in its texture; it is excessively tough, it has lost all its elasticity, and is converted into a dense fibrous membrane. *The age of the patient* has an influence in sympathetic ophthalmia. The young are more liable to it than the old, and it runs its course more rapidly in the child or young adult than it does in the middle-aged or the old.

The Period at which Sympathetic Ophthalmia may come on after Injury.—It is impossible to assign any date at which sympathetic ophthalmia may be expected, or after which the sound eye may be considered as safe. It is seldom seen earlier than two or three weeks after the injury, and generally much later. So long as the irritation primarily excited by the injury continues, the sound eye may sympathise. The risk cannot be said to have passed away until the injured eye has quite recovered; the sclerotic must have regained its normal whiteness and all photophobia and lacrymation have ceased. It is the knowledge of these facts that has often induced the writer to urge upon a patient to have the injured eye removed, when it has drifted into a state of subacute irritability with no tendency to yield to remedies, and when there was no reasonable prospect of the eye regaining useful sight. In such cases, it is better to make a partial sacrifice for the sake of securing the safety of the uninjured eye.

Symptoms.—For the convenience of description, the symptoms of sympathetic ophthalmia may be divided into three stages, a division which, although arbitrary, serves to impress the progress of the disease upon the memory of the surgeon. It must, however, be remembered that, in many cases, the symptoms succeed so rapidly on each other that it is difficult to recognise the division into stages. In some cases, the disease has passed well into the second stage before it is even recognised that the uninjured eye is affected; and this is especially the case in children, from the absence of pain in the early stage of the affection.

In the *first* stage of the attack, the eye is irritable and abnormally sensitive to

light; there is some lacrymation, and the conjunctiva is a little injected; there are usually spotty deposits of lymph on the inner surface of the cornea (corneitis punctata), sometimes only to be detected by looking at the cornea with a lens, and the pupil is sluggish in its action; the power of focussing the eye for near objects is diminished, and the patient is unable to maintain a prolonged accommodative effort. Reading quickly induces fatigue, the words become confused, blurred, and at last indistinguishable; after a few minutes' rest the eye may resume its work, but the same symptoms shortly reappear and oblige it to desist. At this stage of the disease there is generally *no pain*—not even sufficient to draw proper attention to the eye.

In the *second* stage of the disease, fibrinous exudations take place within the eye, and lymph is effused, as an infiltration, into the different tissues involved in the inflammation; the pupillary area of the capsule of the lens is covered, and the iris almost soaked with it. This exudation rapidly becomes organised, and contracts firm adhesions between the whole posterior surface of the iris and the lens-capsule. If atropine be dropped into the eye, the pupil is either not affected by it or it dilates only slowly, irregularly, and partially. The aqueous becomes serous, and the striation of the iris, at first indistinct, is afterwards completely lost.

The *third* stage of the disease is characterised by increased tension of the globe, and this condition is *generally associated with pain*, oftentimes very severe, and sufficient to make the patient willing to submit to any means suggested for his relief. The increase of tension may come on at any time after the inflammatory exudations within the eye have commenced, and may continue during many months, or even last beyond a year. If the disease runs on, the vitreous atrophies, loses its consistence and diminishes in bulk, and the eye gradually becomes softer than normal and sinks to -T 2 or 3. As the atrophy of the vitreous proceeds, the retina is deprived of its normal support, and, falling forwards, becomes partly or completely detached.

The increased tension of the eye, combined with the inflammatory changes in the ciliary region, sometimes leads to a thinning of the sclerotic around the cornea, and to ciliary staphyloma.

Treatment.—Sympathetic ophthalmia is certainly one of the most intractable of all the affections of the eye. Many cases go on from bad to worse until the eye

is lost, and this in spite of what appears to have been judicious and careful treatment from the very commencement of the disease. Still, we occasionally meet with bright results, although these are comparatively few.

The *treatment* will be considered under three headings:—1. How to arrest the progress of the disease. 2. How to proceed when the injured eye still retains some useful sight. 3. The general constitutional and local treatment in each of the three stages of the affection.

1. *How to Arrest the Progress of the Disease.*—If the sympathetic inflammation of one eye is dependent on injury to the other, and it is clear that the wounded eye is irreparably blind; or if the exciting cause of the mischief proceeds from a previously lost eye becoming inflamed, then there cannot be a moment's hesitation about the propriety of at once extirpating the injured or the diseased eye. The importance of removing at an early period an eye which has been so injured as to be useless, and which is exciting, or is likely to excite, irritation in the other, or the inflamed remnant of a lost eye which is acting as an irritant, cannot be exaggerated. For, though, in the *very early stage* of sympathetic ophthalmia, the removal of the cause of irritation will frequently cause its subsidence, yet, when the disease has thoroughly taken hold of the sound eye, even the removal of the lost one will rarely arrest its progress. The writer's experience leads him to believe that if an injured eye be excised before symptoms of irritation occur in the other eye, then the sound eye is safe from sympathetic ophthalmia. There may be exceptions to this rule, but they are probably very few.

Division of the optic nerve has been suggested to take the place of excision of the injured eye. Experience, however, has shown that optic neurotomy of the injured eye does not succeed in warding off sympathetic ophthalmia. Pagenstecher published a case in Knapp's *Archiv f. Ophthalm.* viii., where the optic nerve had been torn off, and yet sympathetic ophthalmia occurred in the other eye. Cases of sympathetic ophthalmia have also come on in the other eye after the optic nerve in the injured one had been divided. We may therefore consider that the division of the optic nerve of the injured eye fails to arrest the disease. From the experience we possess of the power nerves possess of reuniting, it is difficult to understand how the division of the optic nerve could arrest the develop-

ment of sympathetic ophthalmia, as, supposing that the transmission of the *materies morbi* is through the lymphatic spaces of the optic nerve, these spaces would have again become continuous after union of the nerve had been effected.

2. *How to proceed if the Injured Eye still retains some Sight.*—On several occasions the sound eye has been destroyed by sympathetic ophthalmia, while the injured eye has ultimately so recovered that useful sight has been restored to it, and the patient has been able to get about without assistance. As the removal of the injured eye will probably not arrest the sympathetic ophthalmia, and especially if plastic exudations have commenced, the conclusion at which the writer has arrived is, that if sympathetic ophthalmia be established, the injured eye should not be removed if it retains any useful sight.

3. *General Constitutional and Local Treatment.*—In the early stage of the disease, absolute rest to the eyes is imperatively demanded; all reading, writing, or fine work of any kind must be forbidden. When at home, the rooms should be darkened, and when out, very dark neutral-tinted glass goggles should be worn. It is impossible to overrate the importance of keeping the patient for a long period in a very subdued light; it affords the best hope of success, and places the eyes in a position to receive most favourably the influence of any other treatment which may be adopted. However well the patient may progress, the order to rest the eyes and abstain from work should not be rescinded for at least from six to eight months. The disease is very recurrent in its nature, and the too early exposure of the eyes to the stimulus of strong light will increase the chances of relapse.

During this stage, mercurial inunction into the temple with unguent. hydrarg. or the hydrarg. oleat. five per cent. cum morphiâ, may be tried and continued for two or three months, care being taken to avoid salivation by diminishing or omitting the rubbing in for a few days, as required. The patient should be well fed, as the disease is very depressing, and quinine in 1- or 2-grain doses, according to the age of the patient, combined with small doses of the extract of belladonna, or bark with the succus belladonnæ, may be given. From the use of iodide of potassium and perchloride of mercury—both of them favourite medicines in the treatment of irido-choroiditis—the writer has never known the slightest benefit.

Local Applications.—A weak solution of atropine, gr. j. to the ounce of distilled water, may be dropped into the eye three or four times a day; or a belladonna lotion may be frequently used. In the later stages of the disease, when the whole posterior surface of the iris is adherent to the capsule of the lens, all mydriatics do harm by stimulating the dilating fibres of the iris to contract when, from the adhesion of the iris to the lens-capsule, they cannot act. Mydriatics also favour the development of the state of increased tension which usually comes on at a later period of the disease.

In the *second stage* of the disease, when the union between the iris and lens-capsule has been effected, but after the acute symptoms have subsided and the eye is quiet, it is a question whether an operation may be attempted to improve the sight. The writer's opinion is, that if the sight is sufficient for immediate requirements, and will enable the patient to walk about without assistance, the eye should be left alone. It is the only eye; and operations on eyes sympathetically inflamed are so unfavourable, that it is better to let the patient enjoy the sight he has rather than to risk the loss of it with the prospect only of a slight improvement. If, however, the sight is so defective as to be almost useless, and there is a fair field of vision, then an attempt should be made to improve it by an operation; but no operation should be performed whilst the eye is inflamed. The objects to be attained are the formation of a new pupil and the extraction of the lens. There are very few eyes which have suffered from sympathetic ophthalmia, in which an artificial pupil can be satisfactorily made without, at the same time, removing the lens. The iris has become so changed in structure, and so adherent to the lens-capsule, that it is difficult and often impossible to perform an iridectomy; and even when this can be accomplished, it usually fails to benefit the sight from the exposed capsule of the lens being coated with adherent uvea. It is, therefore, generally advisable to endeavour to remove a portion of the iris and to extract the lens in the one operation. First, make a section of the cornea with a fine Graefe's cataract-knife; then, if possible, remove a portion of iris; but, failing to accomplish this, tear open the pupil and through the capsule of the lens with a cystotome; or, if this be insufficient, remove a portion of the iris and the adherent lens-capsule with a pair of iris-scissors; and, lastly, with a little pressure on the globe with the back of the

curette, cause the escape of the lens through the corneal wound. This operation may generally be accomplished without the loss of any vitreous, and the eye will usually recover from its effects well; but the pupil will probably again become closed. Another operation will afterwards be required for the formation of a new pupil. The extraction of the lens seems to exert a beneficial influence on the eye, as, after it has recovered from the effects of the operation, it is much less disposed than it was before to a recurrence of the inflammation.

In the *third stage* of the disease, when there is an increased tension of the eye, active treatment is necessary. If the state of tension be long continued, the little sight that is left soon vanishes, and relief also is required for the pain which so frequently accompanies the tension. An attempt to do an iridectomy the writer has always found unsuccessful. In these cases sclerotomy is a useful operation. A narrow Graefe's cataract-knife is to be made to pierce the sclerotic just external to the corneo-sclerotic junction, and to be directed across the front of the iris to a corresponding point on the opposite side. After slight cutting, so as to make the section a little broader than the breadth of the blade, the knife is to be withdrawn, leaving a wide bridge between the sections. Sclerotomy may be performed, in sympathetic ophthalmia, where there has been great pain associated with increased tension, and in cases where there have been pain, tension, and ciliary staphyloma, and with very good results.

Of the *pathology* of sympathetic ophthalmia we know but little. There is, however, one remarkable fact with reference to its exciting cause, which is, the important part the iris, or some part of its continuation, the ciliary processes or choroid, plays in originating the disease in the other eye. Looking over all the causes which induce sympathetic ophthalmia, we find that either the iris, ciliary processes, or choroid are invariably involved. In injuries of the eye, it is the wounds in the ciliary region; in corneal wounds, it is the entanglement of iris; after cataract or other operations, it is the prolapse of the iris which gives rise to sympathetic ophthalmia.

In the lodgment of foreign bodies within the eye, the danger is when the foreign body is embedded in the iris or the ciliary processes, or when it has gone still deeper and is buried in the choroid, or from lying on the retina it presses on the choroid. Sympathetic ophthalmia may arise from a chip

of metal which has penetrated the cornea without wounding the iris, and lodged itself in the lens. So long as it remains in the lens the other eye is safe; the danger is that, with the absorption of the lenticular matter, it may become detached from the lens, and fall to the deeper parts of the eye. Again, a fragment of a gun-cap has been seen in the vitreous, and there it remained for a long period without producing any irritation; the danger was that it might become detached from its bed in the vitreous, and then produce irritation in the other eye.

Detachments of the retina, even from violence, fail to produce sympathetic ophthalmia. There may be hæmorrhage from the choroid detaching a large portion of the retina—accidents which are of frequent occurrence; and yet no sympathetic ophthalmia. The extensive detachments of the retina from other causes, which lead to blindness of the eye, do not produce sympathetic ophthalmia; in such cases, it is the degenerative changes in the choroid which take place at a long period after the detachment of the retina, which cause the other eye to suffer. So, also, in eyes which have been long lost from any cause, it is the degenerative changes in the choroid which excite sympathetic irritation and ophthalmia in the sound eye. In cases of displacement of the lens from blows on the eye, no matter whether the dislocation be partial or complete, the danger lies in the pressure which the displaced or swinging lens exercises on either the iris, ciliary processes, or choroid.

It is very difficult to say through what channels the inflammation of the injured eye is transmitted to the sound one—whether the sympathetic ophthalmia is due to reflected nerve-action, or whether the inflammation is propagated by simple extension along some special track. The pathology of the disease is still under investigation, and, until we know more of it, it is useless to harass the mind of the surgeon with mere hypotheses.

GEORGE LAWSON.

SYMPHYSIOTOMY (SIGAULT'S OPERATION).—This operation was originally proposed by a Parisian medical student named Jean René Sigault, in 1769, and was first performed by him in 1777, with a successful result.

The pubic symphysis is divided in cases in which contraction of the pelvis prevents natural delivery; the pubic bones are thus allowed to separate, the sacro-iliac synchon-

droses acting as hinges. The child is then born by the natural process.

The early operations were chiefly performed in France, with some few in Germany, Belgium, Holland, and Spain, and one only in England, which terminated fatally to both mother and child. The operation then found favour in Italy, and was extensively performed in Naples, but died out in 1858.

Dr. Harris, of Philadelphia, U.S., has tabulated 70 cases, with the loss of 26 mothers and 47 children. In 1866 it was revived in Naples, and from that time to the end of 1880, 50 cases were operated upon; 40 mothers recovered and 41 children.

The operation being chiefly in the interest of the child, the large infantile mortality told against its adoption. As regards the maternal mortality, however, it compares very favourably with the results of Cæsarean section; and if the complete results of embryulcia could be collected, symphysiotomy would probably hold its own in comparison with these operations.

Operation.—In Naples the symphysis is divided subcutaneously with a probe-pointed and sickle-shaped knife. An opening is first made in the skin above the pubic arch, then the knife is passed carefully behind it, and the section is made by cutting from below upwards. With careful antiseptic precautions this should not be a dangerous procedure. In about one case in four the forceps are applied to aid the birth of the child. The pubic bones are fixed by an immovable apparatus as soon as possible after the operation. Asymmetry of the pelvis may make it difficult to exactly hit the cartilage in performing the section, and a corner of one bone may be sliced off; but this would be of no consequence in a thoroughly aseptic case.

Metroperitonitis was the cause of death in the majority of the fatal cases in the recent Neapolitan revival; and though only one of these is specified as septic, it is probable that sepsis was the chief agent in the production of the fatal inflammation.

J. KNOWSLEY THORNTON.

SYNOVIAL MEMBRANE, Pulpy Degeneration of.—This term is applied to a condition of the synovial membrane resulting from chronic inflammation, in which the delicate membrane of health is replaced by a thick, semi-opaque, gelatinous mass of tissue, of low organisation and degenerative tendency.

This growth usually affects uniformly the whole synovial membrane of the joint;

it may attain the thickness of a quarter or half an inch; it is of a dull yellow colour, varied here and there with spots and streaks of whiter hue, and the red lines of a few small blood-vessels; its consistency varies from a gelatinous softness to a considerable degree of toughness. In advanced cases numerous points of fatty softening and of suppuration are seen; and its free surface may be covered with a layer of pus-secreting granulation-tissue. It adheres to the cartilages, and bulges into all the less resistant parts of the joint.

Sections of this material exhibit, under the microscope, a delicate fibrillated stroma, containing in its meshes free nuclei and nucleated cells of varying size and shape, but mostly of somewhat oval outline.

These changes in the synovial membrane are accompanied by symptoms of chronic joint-disease. At first, there is but slight swelling and heat, with a little tenderness, often of limited area; but, as the disease progresses and the synovial membrane becomes more thickened and pulpy, the bony outlines of the joint are concealed by a general elastic swelling, giving to the touch a deceptive sense of fluctuation. The ligaments soften, the cartilages ulcerate, the bone-surfaces become displaced, and the functions of the joint are slowly but surely lost. Eventually, suppuration usually occurs in some part of the thickened tissue, and matter makes its way either to the surface or the interior of the joint.

The *treatment* of this disease consists in long-continued rest and counter-irritation, together with such constitutional measures as tend to improve the general nutrition of the patient. But, in its advanced stages, the changes are irremediable, and the best that can be hoped for is a permanently crippled joint. The alternatives, therefore, are—(1) To apply a splint, restrict movement, and avoid the use of the joint, leaving it lamed but painless and quiescent; (2) to open the joint and remove the diseased tissue by scraping or solution; (3) excision, whereby the articular surfaces, together with the altered synovial membrane, are removed, and an ankylosed limb or a false joint results. *See* JOINTS, Diseases of.

J. WARRINGTON HAWARD.

SYNOVITIS.—ACUTE SYNOVITIS.—The synovial membrane is, of all the joint-structures, the most commonly inflamed. It is exceedingly sensitive to injury and to the presence of any septic material, whether introduced by a wound or circulating in the blood. Thus, the majority of cases of acute

synovitis are of traumatic, septic, or rheumatic origin; and most acute joint-diseases commence as inflammation of the synovial membrane.

The *symptoms* of acute synovitis are pain, heat, and swelling of the affected joint, in addition to which there is pyrexia, of a degree proportionate to the size of the joint and the activity of the process. The pain is increased by movement; if the joint be superficial, its increased temperature can be easily felt by the hand; the swelling is limited by the synovial reflexions, it is elastic and fluctuant, and conceals the outlines of the articular ends of the bones.

If a joint be examined in the early stages of acute synovitis, the membrane is seen to be swollen and of bright red colour, and the cavity of the joint contains a quantity of synovial fluid of varying turbidity. The microscope shows the redness of the membrane to be due to dilatation of its vessels and increased vascularity, and the turbidity of the fluid to be owing to the presence of leucocytes and shreds of fibrinous lymph. As the inflammation advances, the synovial fluid becomes more turbid, the cellular elements increase, and eventually pus is formed. When this stage is reached, however, the process has usually spread to the other joint-structures; the cartilages undergo ulceration, the ligaments soften, and the bones are exposed. On the other hand, the inflammation may subside, and either assume the chronic form or undergo complete resolution and recovery.

Acute suppurative synovitis is usually of septic origin, and is accompanied by grave constitutional disturbance. Rigors (especially if repeated); increased pyrexia, with dry tongue; and œdema of the soft parts round the joint, may generally be taken as indications that suppuration has occurred. See PYÆMIA.

Traumatic synovitis in a healthy person will probably subside, under proper treatment, without suppuration, if there be no wound of the joint. If there be a wound, suppuration is more frequent, and its occurrence will depend chiefly upon whether septic material obtains access to the joint or not. See JOINTS, Wounds of.

Rheumatic synovitis tends rather to adhesion than suppuration.

Treatment.—If the synovitis be of traumatic origin in a healthy person, the treatment should be antiphlogistic and decided. The joint being secured in a position of rest, leeches or cold should be applied. If, in spite of this, the tension remains great, the

fluid should be withdrawn from the synovial cavity by antiseptic aspiration. Subsequently, elastic pressure must be maintained over the joint, and, if fluid remains, blisters will be needed.

In septic synovitis quinine is indicated; and in the rheumatic form, alkalies, the salicylates, and opium.

When suppuration has occurred, and the presence of pus within the joint has been ascertained by tentative puncture, one or more incisions must be made in such a position as will ensure the free drainage of the joint; the cavity must be washed out with antiseptic solution, a drainage-tube inserted, and antiseptic dressings applied. Recovery with a movable joint may ensue, but ankylosis is the more common result.

SUBACUTE SYNOVITIS is closely allied to the acute form both in causation and symptoms, but the process is one of much less activity and virulence, with correspondingly mild constitutional disturbance. Gonorrhœal synovitis, which is a mild form of septic inflammation, comes into this division; and similar forms of articular disease occur in connection with vaginitis, scarlatina, typhoid fever, and other sources of blood-poisoning. See GONORRHOËAL RHEUMATISM.

Here, the *treatment* must be directed to the cure of the source of infection, at the same time that the joint-inflammation is combated by rest, blisters, and pressure. In these cases there is a great tendency to the formation of adhesions, which must be subsequently treated by rupture and passive movement. Some cases of subacute synovitis lead to a persistent, passive effusion into the joint, which resists the ordinary methods of treatment, and is called ‘hydrops articuli.’ For this, aspiration of the joint, followed by elastic pressure, must be used, and if this fail, the joint may be injected with weak antiseptic solutions, as that of carbolic acid (1 per cent.) or of iodine (1 or tincture of iodine to 10 or 20 of water).

CHRONIC SYNOVITIS may result from the subsidence of the acute forms or from neglect of treatment, but is more often due to some constitutional condition which predisposes to chronic joint-disease.

The *symptoms* are a slowly progressive, indolent swelling of the joint, due partly to fluid in its cavity, but chiefly to thickening of the synovial membrane; slight pain, tenderness, and increase of temperature, and some restriction of movement. As the disease advances, the synovial membrane undergoes pulpy or gelatinous degeneration, and, bulging into all the less resistant

parts of the joint, gives rise to a deceptive sense of fluctuation. At the same time the functions of the joint become increasingly impeded, and the limb correspondingly lame. Eventually, suppuration occurs within the substance or upon the surface of the diseased membrane, and the joint becomes slowly destroyed.

Treatment.—In the earlier stages of chronic synovitis, the treatment will consist in keeping the joint at rest and the use of counter-irritation; while at the same time the health and reparative powers are by all possible means improved. Counter-irritation, as by blisters or the actual cautery, may be followed by pressure in the form of india-rubber bandages or strapping over mercurial ointment. Subsequently friction, shampooing, and passive movement may be used.

But if the stage of pulpy degeneration has been reached, nothing but the removal of the diseased membrane will avail; and this may be done, either by excision of the joint, or by incision combined with scraping or solution, with strict antiseptic precautions. For scraping away the diseased tissue a Volkmann's spoon is the most convenient instrument; for its solution the best method is to introduce into the joint, through lateral incisions, strips of lint soaked in a solution of sulphuric acid in two parts of water.

When suppuration has occurred, the same measures may be used for cleansing the joint; but if the health be much deteriorated and the reparative powers impaired, amputation will be indicated.

J. WARRINGTON HAWARD.

SYPHILIS.—It is important to recognise that syphilis is by no means necessarily a venereal disease. Its various phenomena result from the introduction into the patient's system of a specific poison; and this poison, in all probability, consists of particulate or formed elements. It can be conveyed from one person to another only by direct contact of surfaces. The thinner and more delicate the tissues exposed to this contagion, the more easy is the implantation of the virus. It does not matter in the least upon what part of the body the contagion is effected, for syphilis is always one and the same disease, and is modified in its course only by the inherent peculiarities of the person acquiring it, and the antidotal drugs which are used against it. It is obvious that the venereal act affords peculiar facilities for the transference of a virus of this kind. Hence the fact that syphilis in the vast majority of cases is communicated

in this way, and hence its popular synonym. We meet, however, in practice, with numerous cases in which the contagion takes place upon parts distant from the genitals. See FINGER-CHANCRE; LIPS, Diseases of the.

The early stages of syphilis are probably very uniform in their duration; quite as much so as those of the exanthemata. We may conveniently specify these stages as: (1) the period which intervenes between the day of contagion and the first evidence of local change; (2) that which occurs before the full development of local peculiarities; and (3) that which precedes the appearance of constitutional symptoms. Syphilis, like the exanthems just alluded to, is followed in due course, after the poison has had time to breed in the blood, by constitutional symptoms. Those symptoms are febrile disturbance, sometimes acute, sometimes almost absent, an eruption on the skin and mucous surfaces, and transitory congestions or inflammations of the most various organs and tissues. It is customary to speak of the local phenomena resulting directly from the contagion as *primary* symptoms, and of those which follow when the whole blood is poisoned, as *secondary* or constitutional; whilst the terms *tertiary* and *remote* are reserved for a different class of phenomena, which may appear at very various periods after the primary and secondary have long cleared away.

Although, as has just been asserted, the stages of syphilis are, probably, when not influenced by antidotal treatment, very uniform, yet it must be clearly recognised that its severity varies very much in different individuals. This remark applies to all its stages and the whole series of its very varied phenomena. Without any reference to the health of the individual, to his age, to the part inoculated, or to the source of the virus, we may witness, both in the primary and the secondary symptoms, the widest possible differences as regards severity. The secondary stage may be almost fatal in one case and scarcely recognisable in another; the tertiary phenomena never happen at all in a vast number of persons who have suffered very severely in the secondary period, whilst they may affect with great pertinacity, in exceptional instances, those who have suffered very little in the early stages. Differences in treatment no doubt account, to some extent, for these apparent discrepancies, but certainly not for the whole. There remains much which can be explained only by the idio-

synergy of the individual. A similar remark is equally true of the specific fevers known as the exanthems.

The study of the first stage of syphilis has been rendered much more difficult, than would otherwise have been the case, by the fact that its contagion is rarely effected by a pure fluid. In a majority of cases, not only is the particulate virus of syphilis implanted, but with it the contagious products of peculiar forms of inflammatory action. In this way the local or primary symptoms are often complicated, and we witness on the same spot the results of the implantation of inflammatory material and of the true virus. Further, it may and often does happen, that either a contagion from the inflammatory material alone takes place, or that the effects of this entirely overpower and destroy the specific virus which was mixed with it.

THE PRIMARY SORE.—If the virus of syphilis in a pure form be inoculated, it rarely produces any irritation at first. A period of from three to five weeks will elapse before anything is observed. At the end of that time, a little red spot will be noticed, which itches more or less, and which, extending from day to day, soon becomes a papule, and by the end of a week or ten days is probably a little indurated disc or button. The induration is usually very marked, and its margins definite. There is not much surrounding inflammation, and the surface of the ulcer usually secretes but little. In some cases, indeed, there may be no ulceration whatever, and not the slightest secretion. At the end of five or six weeks, from the date of contagion, the induration will be probably marked. It will continue for a longer or shorter period (usually in relation to treatment pursued), but it never, even when wholly let alone, persists indefinitely, and frequently it vanishes after a very short duration. Occasionally it may last for months. The number of these indurated spots, or chancres, will depend upon the number of different places which were inoculated in the first instance, just as is the case with vaccination vesicles. It is not very often that more than one is seen, and if there be two, three, or more, they are always at the same stage of progress at the same time. No new ones are ever produced subsequently to the full development of the first. If, for the sake of experiment, it were attempted by direct inoculation to produce others, the attempt would fail, just as we should fail to revaccinate an infant, on the eighth day, from his own spots. *See* CHANCER.

Simultaneously with the development of local induration, there is usually an enlargement and hardening of the nearest lymphatic glands. If the sore be on the finger, the glands in the armpit will enlarge; if on the lip, those under the jaw; if on the genitals, those in the groin. The character of the enlargement of the glands will be similar to that of the primary sore; that is, there will be great hardening and very little tendency to diffuse inflammation. The glands will remain separate from one another, and more or less movable. The degree of induration will often be such as to justify the term 'bullet bubo.' This term, however, is much more frequently applicable to enlarged glands in the groin than elsewhere. In the armpit and under the jaw the buboes often consist of glands as large as walnuts, and by no means very hard. Suppuration is, however, even less frequent in these regions than in the groin. *See* BUBO.

The conditions which result from the implantation of inflammatory, or from mixed, products are different. It would appear that some of the inflammations resulting from syphilis, but not attended by the actual presence of the virus, may produce a peculiarly irritating and very contagious secretion. This secretion, if inoculated, promptly produces inflammation. Sores form within a day or two of its contact, which are attended by ulceration, and by the secretion of pus which is capable, in its turn, of inoculating other parts. Hence, these sores may not only be multiple in the beginning, but they may become multiple afterwards. If the experiment of artificial inoculation on some other part of the patient's person be tried, it may easily be proved that he is in no sense protected, since sores of a precisely similar character will be produced. Inasmuch as sores of this kind never show definite induration, they are often spoken of as 'soft'; but it must be clearly remembered that it is quite possible that one or more of them may, at the end of the four weeks' incubation-period, take on induration. It must also be most clearly understood that, although the infecting sore in its typical condition is usually hard, it does not by any means always assume that character. The popular division of sores into 'soft' and 'hard' is productive of very numerous mistakes, since many infecting sores are never hard, and many which are without any trace of hardness at one stage may assume it at another.

The characters of these non-indurated, pus-secreting sores are very various; but

their most usual features are those of an abruptly margined ulcer, having cut or punched-out edges, with a grey, unhealthy surface, and with much surrounding inflammation. It is a remarkable fact, that the non-indurated sore is almost never recognised excepting on the genitals. We must explain this, probably, by the suggestion that the vitality of the pus-elements is much lower than that of the true virus of syphilis. Thus, should they come in contact with the lip or the finger, or even with an abrasion or a wound, they would probably be easily washed off and got rid of. The mucous folds on the genital organs, however, afford the pus a protection, and thus favour the success of its contagion. It may be, also, that non-specific sores on other parts are seldom diagnosed as such, since they present no features which are characteristic beyond dispute. The non-indurated sore, like the hard one, is very prone to cause enlargement of the lymphatic glands, and, as in the former case, this enlargement is of the same type as that of the sore which produced it. It is attended by excess of inflammation. The affected glands swell greatly, and, the intervening tissue being involved, they become glued together in one mass. Suppuration both within and around the glands, instead of being the exception, is the rule.

It is quite possible for a patient to suffer from non-indurated sores and suppurating bubo, without having subsequently any constitutional phenomena. Many such cases occur. It is probable, however, that they are far less common than is generally believed, and that, in a majority of cases, sores which are at first and remain throughout their course diagnosed 'soft,' prove to be infecting. The surgeon must be most cautiously on his guard in giving opinions on this point; for, if the patient has never had syphilis before, whatever may be the characters of any primary sore which he may exhibit, the chances are two to one that the sequel will prove that it contained the germs of true syphilis. The terms infecting and non-infecting, or true chancre and false chancre, might perhaps conveniently displace the adjectives 'soft' and 'hard.' Whatever terms we use, however, we must clearly understand that softness very often precedes induration, that the infecting is not always hard, or, to state it in other words, that the soft may often prove to be infecting. So also with the bubo; an infecting sore may often cause suppuration of the glands, and a non-infecting sore may be attended by a quite moderate degree of enlargement of

glands, which never show any tendency to suppurate. Such being the facts, it is absurd to attempt the formation of sharply-defined rules in the diagnosis of chancre. The general precepts in use are, however, safe enough if we are content to apply them lightly, and careful to remember that they have many exceptions.

It is desirable, at this point, to say a few words as to the relation of the very peculiar disease known as *herpes* to true syphilis. Herpetic vesicles may occur on the genitals of either sex quite independently of any venereal cause, and if they have occurred once they are very prone to occur again. They are seldom or never seen before puberty, and, in those liable to them, they often appear to follow directly on nocturnal emissions or sexual intercourse.

Herpetic vesicles are recognised by their coming out in a group, consisting of at least three or four, by their developing simultaneously and suddenly, and, if time be permitted, by their spontaneous disappearance. Their relationship to syphilis is very peculiar, and often very puzzling. It would appear that they are liable to follow on both kinds of local sore, the non-infecting as well as the infecting one. And although it is to be admitted that those who have never suffered from syphilis may be liable to recurrent herpes on the genitals, yet it is certain that those who have done so are infinitely more prone to it. In syphilitic subjects, further, herpes is often much more severe than in others. Its sores may last longer and become much larger than they would in others, or some of the vesicles may heal and others may persist, and thus it may become by no means easy to distinguish an herpetic sore from a non-indurated chancre. Since herpes very frequently follows intercourse, the patient will often give a misleading history. There is yet another fallacy which occasionally occurs, for in the careless the existence of almost healed herpes may facilitate the introduction of the syphilitic virus, and thus a true chancre or a group of chancres may follow what was in the first instance herpes.

It is necessary, next, to say a few words about a peculiar type of the inflammatory process which is liable to attack both forms of sore—namely, *phagedæna*.

When an ulcer steadily extends in depth and in area, and when its edge presents little irregularities, as if it had been eaten away by a mouse, it is said to be phagedænic. Very often the edge presents, on careful examination, minute points of slough not bigger than pins' heads, whilst

in more exceptional cases there may be sloughing of large and conspicuous portions, and the spreading will be very rapid. To this latter condition the term *sloughing phagedæna* is given.

Sores which are phagedænic are nearly always painful, and the pain is proportional to the extent and rapidity of the process; they are also very liable to bleed, for it would appear that the arteries adjacent to them often fail to get plugged before they are opened by it. If the ulceration extends deeply, and involves vessels of any considerable size, the hæmorrhage may be very profuse.

A certain degree of power to cause the phagedænic type of inflammation appears to attach itself to several specific animal poisons. Thus, the affections called *can-
crum oris* and *noma*, which are forms of sloughing phagedæna, usually occur in fairly healthy children as the sequelæ of measles or scarlet fever. The syphilitic virus, however, stands pre-eminent in power in this direction, and probably nineteen out of twenty of all forms of phagedænic action, which we encounter in practice, are due either directly or indirectly to its influence. *See PHAGEDÆNA.*

The disease known as hospital phagedæna, which may spread through a hospital, attacking all operation and other wounds, is, not improbably, almost always set going by the admission of a case of syphilitic phagedæna into the wards. The secretions of a phagedænic wound are unquestionably contagious, and they are so not only as regards other individuals, but also in reference to the patient himself. It is in large measure by the contagion of its own secretions that a phagedænic wound continues to spread. Remove those secretions and clean the wound, and the disease will be, in most instances, arrested. In a few cases, however, the constitutional tendency, under which the disease was initiated, is sufficiently strong to begin it again and again, in spite of the most efficient treatment. In these latter cases the use of internal specifics becomes equally important with that of local remedies. *See HOSPITAL GANGRENE.*

Syphilitic inflammations of all kinds and at all stages, whether primary, secondary, or tertiary, are liable to take on phagedænic action. Its most frequent examples, however, occur in connection with primary chancres. Although it is admitted that it may attack the non-infecting as well as the infecting, the writer cannot quote, from his own experience, any example of a well-

characterised, primary, phagedænic sore which did not prove to be infecting. In this statement reference is made only to chancres occurring in those who have not previously suffered from syphilis, for exceptions occur in those who have done so.

Phagedænic action in primary sores may vary much in different cases, being sometimes slight and easily arrested, at others persistent and extensively destructive. In some cases, it may destroy the whole of the penis; and in a few cases, chiefly in young prostitutes, it may end fatally. It appears to be more apt to occur in sores which are concealed under a long prepuce, by which the secretions are retained. But it may attack sores in any position. Whenever a concealed sore becomes painful or liable to bleed, the foreskin should be slit up and free access obtained.

Treatment.—As regards indurated primary sores, if the hardness be such as to justify a positive diagnosis, and if, in further corroboration, there be also the bullet bubo, there can be no question as to the treatment. Mercury should at once be given and applied locally, and under its influence there will ensue, in the most definite manner, softening of the indurated patch and healing of the ulcer. If the mercury be stopped, the induration will recur, and if it be again given, it will again melt away. The excision of an indurated sore, or its destruction by an escharotic, can seldom do any harm, but will rarely be productive of good. The virus has already passed into the lymphatic system, if not into the blood, and the occurrence of induration, for the most part, denotes a stage of development too far advanced for any hope of cure by local treatment. The treatment of non-indurated sores will vary according to the stage at which they are seen. If a patient who has never suffered from syphilis before, and who can give his dates correctly, comes under observation at any period within a fortnight of the contagion, with a single sore, it will certainly be wise to destroy it utterly. For this purpose fuming nitric acid may be used, or, still better, the actual cautery; and if the part affected admit of it, free excision by the cautery had better be done. The shorter the period, the greater will obviously be the chance of success. However short the period, success is not certain, as is proved by well-known facts.

The facts alluded to, however, are not of such a nature as to relieve the surgeon of the duty of giving to those patients

who seek his aid early in the case, such chance of escape as the freest possible local treatment affords. If instead of a single one there be many sores, and much surrounding inflammation, there is then no encouragement to commence an abortive local treatment. In these cases, and in all which come under care late, the local treatment will consist in very free washing of the sores and the application of iodoform. This latter drug has superseded all others for the cure of non-indurated or suppurating sores. It should be dusted into the sore after liberal irrigation, and should be applied also as an ointment, one drachm of iodoform to one ounce of vaseline. Perhaps in nine cases out of ten this application will cause the non-indurated sore to take on healthy action and to heal. There are cases, however, which unexpectedly resist it. For such, mercurial applications are next to be tried; and, should they fail, cauterisations with the acid nitrate of mercury may become needful.

Before the introduction of iodoform, a host of remedies were in much repute, but were all of them frequently disappointing. Amongst these may be mentioned the sulphate or chloride of zinc, the sulphate of copper, borax, and various preparations of opium. There are a few cases in which sores, which are not in the least indurated, will yield to nothing but the internal administration of mercury. These are, however, very exceptional; and it may be asserted that, for the most part, the introduction of iodoform has rendered the treatment of non-indurated sores a very easy matter. The same remark applies to the suppurating stage of true chancres.

Several different measures are of the utmost value in the treatment of phagedæna; and, whilst invariably aggressive if left to itself, it is as almost invariably cured by one or another, or all of them combined. In the first place, we have local measures which have for their object the removal of the secretion or its destruction. Amongst these the application of nitric acid, and the use of the continuous bath, are chief. In most cases one or two free applications of nitric acid will stop phagedæna. It is, however, a painful measure, and, in most cases, equally good results may be obtained by keeping the part immersed in warm water. In a bad case, the patient should remain day and night in a sitz bath; but in less severe ones, he may get into his bed for five or six hours at night. When he leaves the bath, the sore should be dressed

with iodoform. Since the occurrence of phagedæna is almost invariably a concomitant of the infecting sore, mercury ought always to be given unless it definitely disagrees. With the mercury should be combined full doses of iron and opium. If it be unquestionable that mercury does disagree, iodide of potassium should be substituted.

Finally, there are certain cases in which a phagedænic sore, although much benefited by the measures enumerated, may yet decline to heal under any or all of them. In these, healthy processes will almost always result if the patient be sent to the seaside. When once phagedænic action is completely stopped it scarcely ever recurs, a fact which speaks strongly in support of the belief that it is, to a large extent, a local process only.

Having thus far considered the peculiarities of primary sores, we may here dismiss entirely the non-infecting or abortive ones, since they are not productive of any constitutional phenomena, and, though associated with it, are not in any true sense syphilis. We may now proceed to the investigation of the very remarkable train of symptoms which follows the infecting chancre.

THE STAGE OF CONSTITUTIONAL INFECTION (SECONDARY).—The chancre and the bubo make up together the primary or local group of syphilitic symptoms. We shall be very near the mark if we say that definite induration in the chancre is rarely present till five weeks have elapsed from the date of contagion, and that secondary phenomena seldom follow till from two to four weeks later still. There is thus a period of from two to four weeks after it has been possible to recognise the infecting sore for a certainty, before the time at which constitutional symptoms will show themselves. If this period has been well employed, if, in other words, mercury has been freely and adequately given, it is probably quite the exception for any secondary symptoms to occur at all. At any rate, if they do, they are but slightly and very feebly marked. The earlier the mercury is resorted to, the greater the probability that they will be wholly prevented. Even when not permanently prevented, they will usually be much delayed.

It must, unfortunately, be admitted that in a certain number of cases, often apparently the most successful, the sequel will prove that delay only has been accomplished. After even a six months' treatment with mercury, and absolute prevention

during the whole of that time, an outbreak may occur when it is suspended. It is this remarkable power of mercury, as an antidote to syphilis, which has led to such different opinions as to the laws of the natural evolution of the malady. If mercury were never given, we should soon see that syphilis is much more regular in its course and stages than is generally supposed. The order of events in cases not interfered with would be probably somewhat as follows: At the end of about six weeks from the date of contagion, the patient would begin to experience slight malaise and feverishness, and his temperature would rise a little every evening. During the next fortnight, if the skin of his chest and abdomen were carefully inspected, it would be found to be mottled by evanescent patchy congestion, not unlike measles, but more dusky and not so conspicuous. To this term syphilitic roseola is appropriate. It is often very evanescent, present at one part of the day and gone at another, or may last only a few days and then disappear. Simultaneously with it, a little later or a little sooner, symmetrical superficial ulcerations on the tonsils occur, and these, too, may be very transitory, and cause so little annoyance that the patient may be scarcely aware that his throat is sore. As the roseola fades, or it may be before it fades, other types of eruption will follow; and a rash composed of little smooth-topped or slightly scaly papules is the most common. The eruption may, however, vary within very wide limits. It may be a lichen, or it may be pustular; or it may take the impetigo or acne type; or it may be vesicular or bullous; or it may assume the rupia type; or it may be corymbiform (the lichen ruber type); or, lastly, it may be indistinguishable from true variola.

We know respecting syphilis that during its early stages the blood and all products of inflammation may prove the vehicles of the contagion. How long this condition persists we do not know. That the blood may still be contagious, after all external phenomena have vanished, we know from the facts of vaccination-syphilis, and from many instances of accidental inoculation. A vast amount of negative evidence favours the belief that the normal secretions, the saliva, the milk, the sweat, the semen, are not usually, perhaps never, vehicles of contagion. If they were so, syphilis would be far more common than it is. The rarity of the lip-chancres is an almost conclusive fact against the contagion of the saliva. So also, as regards the semen, is the fact

that syphilitic husbands do not usually communicate the disease unless pregnancy ensues. Yet, it is unquestionable that the virus exists in the semen in a manner which permits of spermatoc infection of the embryo. It is possible, however, that this may be a very different thing from the infection of a wound.

A very large amount of negative evidence supports the belief that the virus ceases to exist, in a form efficient for contagion, long before the subject of the disease is free from the risk of relapses. Almost all the examples of accidental contagion occur within short periods from its origin. It is seldom that more than two years can be proved under such circumstances. The primary and all secondary lesions are certainly contagious, and during their persistence the blood is virulent, but after they have ceased, whether from treatment or without, there is reason to believe that the virus does not long remain potent for contagion. No instances of contagion from a tertiary lesion, or from one produced more than five years after the primary disease, are, as far as the writer's knowledge extends, on record. Perhaps the period might be shortened to three years. Yet, long after such periods, the patient continues to be himself liable to various forms of local inflammation consequent on his taint.

The older writers inferred that a man might have syphilis over and over again. Five-and-twenty years ago it was taught, almost universally, that one attack secured immunity from others. We are now again coming back to the old belief. At any rate, we know for certain that second attacks are not very infrequent. The writer has himself had not a few opportunities for observing the course of second attacks, in patients whom he had himself seen during the first. The doctrine that immunity is conferred is, however, to some extent, well founded. Second attacks are exceptional, and when they do occur the disease is almost always modified. Second chancres do not run the usual course. Their induration is often developed quickly, and very quickly passes away, to be followed by nothing definite. For the most part, second contagions result only in non-indurated or abortive sores. Yet, in spite of this being the usual course of events, it is, beyond doubt, quite possible for a man to have complete syphilis twice. Perhaps it is as infrequent as in the case of variola, and to be explained, as in the latter instance, by the idiosyncrasy of the patient. It curiously happened, in the first instance in which the

writer observed a second attack of syphilis, that the patient had experienced two attacks of variola also.

One of the occasional manifestations of secondary syphilis is the production of papillary warts. The fact that we encounter not only the most various modifications of the inflammatory processes, but also conditions which are in the main produced by structural overgrowth, is so remarkable that the writer must refer to it in some detail. The warts which we see in the middle of the dorsum of the tongue are the most simple and definite example of this structural enlargement. They are often unattended by inflammatory infiltration of adjacent parts, and consist simply of hypertrophied papillæ. They wither when mercury is given. Now and then similar warts, directly due to syphilis, are seen on the genitals, and sometimes (but very rarely) the whole skin-eruption assumes a papillary type. The condyloma is, however, much more common than the ordinary wart. It is indeed a variety of wart, and between it and the typical *verruca mollis* we observe all gradations. In the condyloma there is great hypertrophy of papillæ, but these are concealed by the extensive cell-infiltration into the intervening layers. The great thickening of the intima, which occurs as the first stage of syphilitic arteritis, is also, in many instances, a condition of hypertrophy rather than of inflammation. The same remark applies to some of the cases of hypertrophic cirrhosis which we meet with in syphilis, in which there is much diffuse fibrous overgrowth. This fibrous overgrowth may vary much in the amount of its cell-infiltration. The term 'mucous patch,' often used as synonymous with condyloma, should be superseded by mucous wart or papilloma. Many, indeed by far the greater number of true mucous patches, are not attended by any papillary growth. See MUCOUS PATCHES.

Thus, it may be said that the syphilitic virus often causes sclerosis or sclerotic hypertrophy in the first instance, and inflammation, more or less marked, in the second. Sometimes no inflammation occurs, and the chancre may run its course without pain or irritation, without ulceration, and without discharge. Such were probably the conditions, as regards the chancre, in some of the cases in which intelligent and truthful patients, affected by unquestionable syphilis, assure us that they have never had any local sore.

The indurated chancre does not present any features peculiar to itself when ex-

amined by the microscope. It is simply an example of cell-infiltration without giving way of the cellular-tissue fibres amongst which the cells are effused. Hence, perhaps, the explanation of its hardness. Inflammatory action is almost absent, and the process resembles that of a new growth. The hardest chancres are always those which are least inflamed.

In the false chancre, on the contrary, the pus-elements which effect the contagion produce inflammation from the beginning. Even if the specific virus be present also, it is very possible under such conditions that it may be unable to effect any noticeable degree of sclerosis, and thus, as already observed, the sore may rank as soft or suppurating, although it may prove infecting.

At the same time that the skin is affected in constitutional syphilis, the eye, the periosteum of the bones, the bones themselves, the joints, the nervous system, indeed all the tissues of the body, are liable to suffer. Whatever part is attacked, however, the inflammation, although persistent for a certain time, will usually prove transitory in character. Very often, the duration of the phenomena at this stage is exceedingly brief. Just as the patient may have a roseola which lasts only a few weeks, or even only a few days, so it is with periosteal pains, with affections of the eye, and with those of the nervous system. What happens may be a merely temporary congestion, and by no means a definite inflammation. In this, we note a strongly marked difference between all the occurrences in the secondary stage of syphilis and those which are tertiary. The latter, unless cured by treatment, invariably persist, and tend to spread locally. The former, although often for a time very severe, as invariably show a tendency to subside spontaneously.

Other important distinctions between secondary and tertiary syphilis must be insisted upon. The phenomena of the secondary stage are caused by poisoning of the blood, and of the tissues generally through the blood; they are therefore almost always symmetrical, and are developed with accurate sameness of appearance on the two halves of the body. In the tertiary stage it is highly probable that the virus has ceased to exist in the blood, and, in an active form, even in the tissues themselves. Thus, in this stage the phenomena are due to peculiarities, which have been stamped upon the tissues by what occurred during the more or less remote period of blood-poisoning. Local influences have

much to do with the bringing out of these inflammations, but when once produced they are always self-infective, and tend not only to persist, but to advance in adjacent tissues by 'contagion of continuity.' As an example of this may be adduced the well-known horse-shoe sore, a form of syphilitic lupoid affection of the skin, always tertiary, and always tending, unless stopped by treatment, to spread at its edge. To this quality of edge-spreading the term *serpiginous* is applicable, and the *serpiginous* tendency is one of the most important features of difference between the tertiary phenomena of syphilis and those which are secondary. One which is perhaps still more important is, that the tertiary symptoms are, as a rule, not developed with symmetry. They depend far more upon local causes than do the secondary. Thus, there is no reason why they should be symmetrical, and, in fact, they are only exceptionally so. Even when an accidental symmetry is observed, we never witness with it the general distribution, which is another marked feature of the secondary symptoms. As a rule, we may note, also, that the inflammations which occur in the secondary stage do not spread at their edges, are not *serpiginous*—a feature in which they resemble those of the other *exanthemata*. The only exception to this occurs in the case of *phagedænic* ulcerations, and in these, as has been already explained, the *phagedæna* is not in a strict sense part of the syphilis, but is due rather to certain peculiar forms of inflammatory secretion which have been produced by it. Thus, if *phagedænic* action should occur in the secondary stage, it never shows any tendency to symmetry of arrangement.

It is desirable now to attempt a more detailed description of the symptoms which we meet with in the secondary period.

THE ERUPTIONS ON THE SKIN IN THE SECONDARY STAGE present so many features of difference that it would be tedious to attempt their separate description. It is a most interesting and remarkable feature, respecting the skin-diseases of syphilis, that they do not, as do the other *exanthemata*, keep to one form. There is, in fact, no single skin-disease of constitutional origin which may not be imitated very closely by an eruption which is due to syphilis. Certain general features of distinction may, however, be noted. First, the imitation is rarely absolutely correct. However close at first sight, the careful observer will almost always note some distinctions, and thus will usually know what name to apply.

Next, there is very frequently a mixing of the types of two or more in the same case. Thus, as is well known, syphilitic eruptions are very commonly polymorphous. We see mixed in the same case, and often in close juxtaposition, papules of psoriasis and of lichen, or the rash may be in part lichenoid and in part pustular. There is a popular belief that the eruptions of secondary syphilis are always of a peculiar colour—a coppery tint, or the colour of the lean of ham, is supposed to constantly characterise them. No doubt this peculiar feature is very often observed, but it is far from invariable, and it is often exceedingly well marked in eruptions which have no relation to syphilis. Those who trust to it, therefore, will be in constant danger of making mistakes. In judging of the colour of syphilitic eruptions, allowance must be made for the temperament of the individual and for the part of the body on which the eruption shows itself. So far as the tint shows itself in pigmentation, we may say that the darker the complexion of the patient the more likely will his eruption be to show a deep copper tint. On the lower extremities, where the venous circulation is at a disadvantage, patches of syphilitic eruption will always be much more dusky, owing to venous congestion, than on other parts.

Next to colour, symmetry, and polymorphism, we have to mention the position on which the spots appear, as aiding us in the diagnosis of secondary syphilitic rashes. The earliest forms of eruption, *roseola*, &c., unquestionably occur on the front of the abdomen, and throughout the whole course of this stage the front of the trunk is very rarely exempt. Very probably the wearing of clothes, especially of woollen, and the warmth of the surface thus preserved, have much to do with this peculiarity of location. We seldom see the early secondary rashes on the face or hands, and if they do occur here it is only in cases of exceptional severity. Next in importance to the abdomen and front of the chest, we have the front surface of the arms; indeed, no region of the body is more constantly affected by secondary syphilis than these parts. The back and sides of the neck are very frequently affected. Although we may, without hesitation, draw a strong line between common psoriasis and syphilitic psoriasis, by saying that the latter usually affects the fronts of the upper extremities and the backs of the lower ones, while it is the reverse in the common form, yet the rule is liable to many exceptions.

Whenever we find psoriasis patches definitely located on the tips of the elbows and fronts of the knees, we may be confident that it is non-specific, but we shall meet with constant exceptions to all other rules as to diagnosis by location.

Next in frequency to the roseolous or blotchy eruption so common in the very earliest stage of secondary symptoms, we must place the papular rash, to which the name psoriasis is usually given. It differs from non-syphilitic psoriasis not only, as just observed, in the localities affected, but also in its general characters. It seldom, like common psoriasis, affects large areas, but is usually seen in small spots (from a pea to a sixpence in size), and it is never conspicuously scaly. The white silvery scale-crust usually present in the non-syphilitic form is seldom seen in the specific one. Not infrequently the papule, upon which the scales are scantily placed, shows so much thickening that the term tubercle might become appropriate. From these features, and from the fact that the various spots often differ a good deal from one another in the same individual, it is not often difficult to make the diagnosis, even without help from the history of the case. Amongst the less common of the syphilitic rashes we have the following:—

In *lichen* we meet with little red or dusky pimples scattered over the whole surface. They are often very thickly placed, but show little or no tendency to arrangement in groups, and seldom become confluent, or form patches. There is, however, a form of syphilitic lichen in which the spots are arranged in long, corymbose groups, or in streaks, exactly resembling those seen in lichen ruber, and sometimes these become flat-topped and polished as in lichen planus. The exact imitation of these peculiar forms of skin-eruption by syphilitic rashes is very remarkable, and the diagnosis is often exceedingly difficult. The mistake most usual is taking the non-syphilitic eruption for a specific one, and rejection of the patient's denial that he has ever run the risk of acquiring the latter. Lichen ruber and lichen planus are often dusky or copper-tinted, and present all the features which, to those of limited experience, suggest a confident diagnosis of syphilis.

Although a syphilitic eruption, looking closely like *small-pox*, is very rare, yet the knowledge of its possible occurrence is of extreme importance. The imitation, when it does occur, is very perfect. The papules are elevated, shotty to the finger, have depressed centres, affect the same regions as

variola, and resemble it so absolutely that nothing but the history of the case can help the surgeon to a correct opinion. In proof of this statement, it may be stated that it is not at all unknown for patients presenting this type of syphilitic eruption to be sent to the small-pox hospitals, and there to obtain admission and prolonged treatment. This simulation of the variolous eruption by syphilis is the most marked example of 'syphilitic imitation' which can be adduced, but it is only one of many. By far the easiest clue to the recognition of the syphilitic skin-diseases is the acceptance of this general law: *Syphilis may imitate all known forms of skin-disease, but it can produce no originals.* All the known names for skin-diseases (excluding those of merely local origin) may in turn receive the adjective *syphilitic* before them. When they do so, that adjective becomes, of course, all important, and wholly swamps the designation to which it is appended. Of the exanthemata, not only variola but varicella, rubeola, and scarlatina may be thus imitated. The rash caused by copaiba is often exactly like a syphilide, or, what amounts to the same thing, syphilitic rashes are like it. Forms of inflammation, exactly like those called lupus, are very common as the results of syphilis, and it is the same with alopecia, leucoderma, true leprosy, and many others. We see here the importance of a correct appreciation of the patient's history. When any one of the evanescent eruptions is simulated by syphilis, the mere lapse of time clears up the diagnosis, though unfortunately often not early enough to save the surgeon's reputation. The supposed variola or copaiba rash does not fade at the proper time, but persists for weeks together, and thus proves itself a syphilide.

The eruption known as *rupia* is an important and peculiar one. The term *rupia prominens* was formerly in use, as applicable to the conical, limpet-shell-like crusts which characterise this eruption. *Rupia prominens* is of all others the most easy skin-disease to represent in a portrait, and good pictures of it occur in all atlases. It can scarcely occur excepting when the treatment has been neglected. *Rupia* is rarely the original form of eruption, but usually results from the ulceration of papules. This ulceration, gradually extending at its base, and producing a secretion, which is not very abundant but which quickly dries, causes the crust to enlarge in circumference and increase in height. Sometimes, and in the most typical cases, a bulla precedes

the formation of a crust. Rupia invariably leaves scars, and they are almost always round. There has been much misapprehension as to whether rupia should rank as a secondary or a tertiary form of eruption. In conformity with the old error that all forms of ulceration should rank as tertiary, it was commonly classed as such. We now know, however, that this feature will not help us. Many secondary lesions, both of skin and mucous membranes, ulcerate, and the chief distinction between secondary and tertiary is as to time of occurrence. Bearing this in mind, we may admit that rupia never occurs very early amongst the secondary phenomena, and that it is almost always preceded by some other form of skin-eruption (roseola, psoriasis, &c.), nor, on the other hand, is it ever seen amongst the late and well-characterised tertiary phenomena. Its usual place is from six to twelve months after the chancre, and in patients who have failed in health under treatment. Sometimes it will persist for long, but, even when it does so, it usually continues to be general and symmetrical.

Whenever an eruption displays these features, and occurs within two years of the chancre, it must rank as secondary, and such is the usual position of rupia. The scars left by it often help us much in the positive recognition of syphilis in patients who have reached the tertiary stage. Such patients do not, however, with the very rarest exceptions, show any rupia patches still extant. If we are careful to diagnose between rupia and certain forms of lupus which somewhat resemble it, we shall be obliged to admit that it belongs almost exclusively to the position assigned to it, and is simply a suppurating modification of a secondary rash. The explanation of the tendency to suppurate is to be sought in some peculiarity in the patient's health, and his susceptibilities to the influence of mercury and iodides. Each of these drugs may in turn appear to aggravate it; and not infrequently it has been developed during their use. The indication is always for the combination of tonics, steel, quinine, or opium, and, above all, for resort to sea air. It is a great mistake to assume, as was formerly done, that mercury is to be avoided when syphilitic sores ulcerate. On the contrary, when used in the associations suggested it will almost always prove the means of cure.

No other conjecture can be given, in explanation of the differences in the eruption which attends syphilis, than that they depend upon the idiosyncrasy of the patient.

They certainly have nothing to do with differences in the poison, for, so far as we know, none such exist. The different types of syphilitic eruption never prevail epidemically, but, as it were, quite by accident. The rare ones are equally rare, and the common ones equally common, at all times and in all places. Nor do differences in health suffice to explain them, for the most severely ulcerating forms sometimes happen to patients who, both before and after their occurrence, appear to enjoy robust health. On the other hand, delicate persons often suffer very lightly from syphilis.

OF THE AFFECTIONS OF THE EYE IN THE SECONDARY STAGE, *iritis* is by far the most common. It usually occurs from three to six months after the chancre, and is thus distinctly secondary. It seldom attacks the two eyes simultaneously, but the second usually suffers after a short interval, and often in spite of successful treatment of the first. The symptoms are, ciliary congestion, a muddy iris, an irregular pupil, and a variable degree of pain and photophobia. Of these, in slight cases, the demonstration of iritic adhesions by the use of atropine is by far the most important. Sometimes, the case never passes the stage of a slight ciliary congestion, which may be gone in a few days. In others, the attack may be attended by severe pain, great congestion, a thickened iris, nodules of rust-coloured effusion in its structure, and a blocked pupil. The result, even in severe cases, is usually restoration of almost perfect sight, but in many instances the eye is damaged, and in some it is destroyed. There is usually but little tendency to relapse when once the cure is well in progress, and it is but very seldom that the disease lapses into a chronic form. In severe cases the vitreous may be affected, and in a few the choroid and the retina are inflamed at the same time. More usually, however, these structures suffer at a somewhat later period, and when the iris is not itself inflamed.

The diagnosis of syphilitic from other forms of *iritis* must depend to a large extent upon the patient's history, and concomitant symptoms. There is nothing in the symptoms distinctive from those which occur in the arthritic form. The little gummata or nodules in the iris are, when they occur, pathognomonic symptoms, but they are seen but rarely. Arthritic *iritis* is, as a rule, attended by much more pain and intolerance of light than is the syphilitic form, whilst the iris is usually less swollen and less muddy. Effusion into the aqueous humour and dotted deposits in the back of

the cornea may occur in both. The history of repeated recurrences (once or twice, perhaps, every year) is very common in the arthritic form, and never occurs in the other. The first aim of treatment in syphilitic iritis is to secure dilatation of the pupil, and for this object atropine drops, four grains to the ounce, must be used every two hours the first day, and less frequently afterwards. The constitutional treatment must be, as for other secondary symptoms, the use of mercury. Iodide of potassium in full and increasing doses will often effect a rapid cure, but it is less certain than mercury. For a patient who was not previously under the influence of either, one grain of the grey powder in pill every three hours, until the gums are touched, will be an efficient treatment. In the meantime the patient should keep his room, live abstemiously, and, if the pain be severe, have leeches to the temple. If it is desirable to combine opium with the mercury, care must be taken that constipation is not induced. On the other hand, diarrhoea is to be avoided. The safety of the eye depends, however, mainly upon the promptitude and efficiency with which atropine is employed. *See IRIS, Diseases of the.*

At a later period (rarely till a year from the date of contagion) the eye may be attacked by *neuro-retinitis* or diffuse retinitis, or by patchy choroiditis (choroiditis disseminata). These affections may occur after iritis has passed off and all treatment been put aside, or in cases in which iritis has never happened. They are both of them rare, and in each case the objective diagnosis must be made by the ophthalmoscope. In both, the subjective symptoms are simply more or less failure of sight with *muscæ*, but without much evidence of congestion, and with little or no intolerance of light. In both, the prompt use of mercury to ptyalism is urgently demanded. This will in most cases effect a cure, often with but very little damage to sight, and with little or no risk of relapse. These forms of retinitis are frequently attended by some opacity of the vitreous. *See CHOROID, Diseases of the; RETINA, Affections of the.*

We have to observe respecting *the mouth and mucous membranes generally*, as in the case of the skin, that various stages of different symptoms are observed in secondary syphilis. The earliest, and usually the very first of all secondary phenomena, are ulcers in the tonsils. These occur symmetrically, and are often very superficial, and almost painless. They are often present without the patient knowing that he

has sore-throat, and often pass away very quickly. The condition is usually a kidney-shaped ulcer, with grey-white borders, like 'snail tracks.' Their presence often helps the diagnosis of constitutional syphilis in its earliest stage. They are usually coincident with the erythematous or roseolous rashes, and, like them, soon pass away. It is not, however, in all cases that they pass off so easily, and when they do so they are often followed by other and more troublesome forms of inflammation of the mouth and throat. It is a very remarkable fact that the syphilitic poison, when freely developed in the blood, can cause not only local inflammations and ulceration, but local growth. These differing processes may often be seen, side by side, in the mouth of the same patient. Patches may form on various parts of the lining of the cheeks and lips, on the gums, and on the tongue, which are simply attended by congestion, slight swelling, and abrasion. These are known under the name of the mucous patch. Upon them we sometimes witness the destruction of the proper papillæ of the tongue, causing the 'bald patch,' whilst in other cases the papillæ are hypertrophied. This hypertrophy may produce either warts or condylomata. Between these the chief difference is that in the latter the overgrown papillæ are fused together by swelling of the intervening tissues, and a flat-topped, elevated area is thus produced, whilst in warts the papillæ are free. There is one particular part of the tongue in which warts are specially prone to grow during syphilis. This is the central region, a little in front of the circumvallate papillæ, which, when the tongue is at rest in the closed mouth, is least in contact with other parts. It is not possible, excepting by the history, to distinguish warts due to syphilis from those in connection with other causes. In the case of the condyloma the diagnosis is usually easy, for nothing resembling it is ever produced, excepting in syphilis.

At the same time that the mouth suffers, the other mucous orifices are very likely to be affected. On the vulva in women, around the anus in both sexes, and under the prepuce in men, mucous patches, condylomata, and warts are very frequently seen. The same remedy which causes the abrasion to heal, and covers the bald patch with freshly-grown papillæ, will also cause the hypertrophies present in warts and condylomata to undergo shrivelling. Thus we may feel sure that both the atrophy and the hypertrophy were the real

results of the syphilitic poison. The development and persistence of syphilitic lesions in the mouth will be much influenced by local conditions. They are far more frequent in smokers than in others, and are also more severe and more lasting. Broken teeth will also often locate syphilitic sores on the tongue or cheeks, and cause them to persist when they would otherwise have healed.

The *tongue* in smokers, and occasionally in those who do not smoke, is apt to pass into a condition of chronic disease. This may assume various forms, being sometimes attended by much general swelling, causing bossy projections, with deep sulci between them, whilst in others it is a superficial change, leading to permanent baldness and sclerosis. The leucomata, or persisting, smooth, white patches, so often seen, must be regarded as the joint result of syphilitic glossitis, and the constantly-recurring irritation of hot tobacco-smoke. In a majority of cases the latter probably takes the larger share. *See* PSORIASIS BUCCALIS; TONGUE, Diseases of the.

The *periostitis* which occurs in the secondary stage of syphilis differs from that of later periods in that it is usually slight in degree and transitory. Definite nodes are very rare. It is common enough, however, for patients in this stage to experience pains in various bones, attended by tenderness on pressure, and sometimes slight swelling—osteocopic pains as they are sometimes called. Rheumatoid pains are also common, and in some cases very severe. Under specific treatment, however, or even without it, these bone and joint affections pass completely away and leave no permanent results. The bones usually affected are precisely those most prone to suffer later on—those of the skull, the tibiae, and the clavicles. When rheumatism is severe in the secondary stage of syphilis, it occurs probably to those in whom there is an inherited tendency to arthritic diseases.

Loss of hair, a general thinning over the whole scalp, sometimes with a tendency to fall in patches, is a very frequent symptom of the secondary stage. It is sometimes attended by affections of the nails. It is usually arrested by the use of mercury, and the hair grows again as well as before.

Not a few patients during the secondary stage of syphilis become a little *deaf*, sometimes in one ear, sometimes in both. In most cases the condition is merely temporary, often lasting only a few days. In exceptional instances, however, absolute deafness is rapidly produced, and is per-

manent. Nothing but the rapid and vigorous use of mercury can save the function in these cases. When severe, both ears are almost always affected. Few, if any, opportunities have occurred for dissecting the ears of those who have become deaf in the manner described, and we have, consequently, no conclusive evidence as to the precise nature of the malady. It may be assumed that it is an affection of the internal ear, and that it is the same as that in the form of deafness which we meet with much more commonly in inherited syphilis. It usually occurs within a year of the primary disease. We do not know of any form of deafness due to syphilis which occurs in the tertiary stage of the acquired form. In the inherited disease, symmetrical keratitis and symmetrical deafness are both of them very common at or about the period of puberty. Although occurring so many years after birth, yet their constant symmetry seems to prove that they belong really to the secondary group. *See* CONGENITAL SYPHILIS. Keratitis and deafness in the acquired disease are almost infinitely rare, but when they do occur it is in the secondary period, and they are symmetrical.

Menière's disease is now and then closely simulated, or perhaps we ought to say produced, by syphilitic affections of the ear. *See* EAR, INTERNAL, Diseases of the.

A large number of those who suffer from constitutional syphilis pass through the secondary stage with very little disturbance of general health. They scarcely know that they are ill. With a minority, however, it is otherwise. Severe pains in the bones and joints occur, there is loss of appetite and failure of strength, and, above all, very marked rise of temperature every evening. These indications of constitutional disturbance are, sometimes, quite out of proportion to the skin-eruption and the other local conditions. It sometimes happens that a patient is confined to bed, and supposed to be the subject of some obscure 'blood-poisoning' with high temperature for weeks together, before the development of a characteristic rash reveals the real nature of the disease. Dr. Duffin, of King's College Hospital, was, probably, one of the first to study systematically the occurrence of febrile temperatures in association with syphilis. A very remarkable example of temperature ranging from 99.8° F. to 105° F. for several weeks was recently brought before the Clinical Society by Dr. Burney Yeo, of the same hospital. Probably, in almost all cases in the early part

of the secondary stage, if the thermometer were regularly used, we should find some tendency to evening exacerbation. Although the fever is sometimes disproportionate to the eruption, it is to be admitted that they are more usually in ratio with each other. The variola-like eruption in particular is almost always attended by much fever, and, indeed, wherever the eruption is unusually free, whatever may be its type, there is commonly more than usual fever. This occurrence of high temperature, simultaneously with the exanthem, is another of the numerous facts which support the belief that syphilis ought to be classed with the specific fevers.

INTERMEDIATE SYMPTOMS.—All the usual phenomena of the secondary stage pass away, in most cases completely, under treatment. In a very large majority, at the end of six months from the date of contagion the patient is again in good health, and apparently quite rid of his disease. Unfortunately, however, in a large number relapses occur, and the patient becomes liable to what have been well designated 'reminders.' These symptoms are of a kind far less severe and aggressive than most of those known as tertiary, and they often in some features ally themselves with those of the secondary stage. Thus they often display themselves symmetrically on the two halves of the body and on the limbs. They seldom, however, resemble the secondary symptoms closely: thus nothing is less common than to see a patient, who has been cured of syphilitic psoriasis or lichen, display the same again in its original characters. The 'reminders,' to which reference is made, usually consist of peeling patches in the palms, sores on the tongue, patches on the scrotum, or it may be a scanty papular eruption over the whole surface. Sometimes sarcocele or gumma of the testis occurs in this association, but more commonly it is later. A very curious liability to a slight and short-lived eruption of erythematous rings is not infrequently noticed. These rings occur on the arms and trunk, and are especially visible after exposure of the surface to either heat or cold. They are noticed just after getting out of bed in the morning or just after a bath, whether hot or cold. The eruption rarely remains out more than an hour, often only a few minutes, but it returns over and over again. The syphilitic nature of this curious eruption is often proved by the entire disappearance of the liability to it after a short course of mercury.

Psoriasis Palmaris.—Peeling patches in the palms often occur during the secondary rash, but more usually they are seen somewhat later. The earlier they happen in the course of the disease the more likely they are to be symmetrical, and the more easily will they be influenced by mercury. On the other hand, the longer the interval the greater is probably the share of local causes, and the more difficult the cure. There is a form of palmar psoriasis which is distinctly tertiary, almost always one-sided, and in which the patches show a tendency to spread serpigiously. It is to some extent a mistake to call the palmar patches by the name of psoriasis. They seldom if ever show any tendency to scale-accumulation, but rather to peeling and destruction of tissue. In the secondary stage, however, numerous separate patches are seen, and although there is never any scale-crust, yet their co-existence with psoriasis on the trunk and limbs seems to denote sameness of type with that eruption.

The form of syphilitic psoriasis which occurs late in the disease, which affects only one hand, is attended by a dusky thickened edge, and which spreads out at its border, assuming the horse-shoe form, is more nearly of the lupus type. It is distinctly tertiary. It may be here remarked, that it is a great mistake to suppose that all forms of palmar psoriasis are syphilitic. In a majority of cases peeling patches in the palm have nothing to do with syphilitic taint, but are in connection either with the dartrous state, with senility, or with purely local influences. See PSORIASIS.

Sarcocele from gumma of the testis is an affection which occurs under much the same conditions as palmar psoriasis. If both testes are affected, the interval since the primary disease will usually be found to have been but short; but if only one, it may have been of several years. Syphilitic affections of the testis are seldom seen either in the early secondary, or later tertiary. They belong distinctly to the intermediate group. In this affection we sometimes meet with distinct masses of deposit in the epididymis. The most common condition, however, is a general enlargement of the whole gland with a smooth rounded exterior. The size attained may be very considerable, possibly as big as a small fist. The enlargement is slow in development, and usually painless. Abscesses may occur if no treatment is resorted to, and these may lead to fungus testis. The syphilitic testis may often be known by its large size, peculiarly rounded outline, and

light specific gravity. A gumma feels decidedly lighter in the hand than either hydrocele or malignant growth. However large the swollen gland may be, and however long the disease may have persisted, the surgeon should never despair of the cure by specifics; mercury and iodide of potassium are both useful, and under their influence the largest and most threatening forms of sarcocele will melt away. The same remark must be extended to cases in which abscess has occurred and been followed by fungus testis. It is never necessary in such cases to excise the gland, however hopeless the condition may look, for under the influence of treatment a cure, so far as a cure is possible, can almost invariably be brought about. See TESTIS, Diseases of the.

It is during this intermediate period that *choroiditis*, if it occur at all, is likely to happen. It is, however, a very rare affection. Sometimes distinct gummata in the choroid may be demonstrated by the ophthalmoscope. These, under specific treatment, may be observed to disappear rapidly, leaving more or less conspicuous scars and patches of atrophy. In other forms, thinning and absorption of the choroid occur without any evidence of previous gummata. With the choroiditis there may be inflammation of the retina or optic nerve, or these latter may occur alone.

Inflammation of the *arteries* in syphilis may occur either as an affection chiefly of the intima or of the adventitia. The middle coat, as a rule, escapes. When the inner coat suffers it becomes thickened, either in plates, or over long tracts, much as in the early stages of non-specific sclerosis. There are no special characters by which the syphilitic form may be distinguished, if we except the general fact that the cell-effusion is usually excessive in syphilis. The changes may advance so as to almost close the artery, or they may lead to ulceration, the detachment of emboli, and the formation of thrombus at the seat of disease. These processes have been chiefly studied in connection with the arteries of the brain, but they may occur in any part. As a primary and independent affection, disease of the intima is probably far more common than that of the external coat. If, however, the arteries be affected secondarily (that is, are involved in association with disease of the tissues in which they pass), then, usually, the adventitious coat suffers first and most severely. It also is the most likely to suffer if arterial

disease should occur late in the course of the malady.

Cerebral disease, consequent on disease of the walls of the vessels, is a very distinct affection from the other brain and nerve disorders which occur from syphilis. It almost always assumes somewhat of the nature of a 'fit.' The arterial condition is one of thrombosis, not of laceration. From this fact it follows that the paralysis (usually hemiplegic) comes on, not suddenly as in hæmorrhage, but somewhat gradually. As the vessels become more and more nearly occluded, the patient experiences tingling, or twitching, or numbness in the limbs about to be affected, and this may last some hours before all power is lost. Now and then, however, the seizure is very sudden. A certain amount of recovery may be confidently expected from this form of paralysis; but it will seldom be quite complete. It not infrequently happens that the patient experiences no relapse, but remains through after-life with a weakened or possibly contracted arm.

It is probable that all the *viscera* are liable to suffer during the latter part of the secondary stage, or even sometimes in its earlier part. They suffer, however, in a manner very different from that which occurs in the tertiary stage. No large nodose gummata are formed, nor are any of the conditions produced at this stage, as a rule, permanent. The process is one of diffuse infiltration, with general congestion, rather than of local growth. The congestion, swelling, and ulceration of the tonsils is the first and commonest evidence of tendency to visceral affection. A little later, there may be engorgement and tenderness of the liver and spleen, and a remarkable failure in the blood-making process. Slight and transitory albuminuria may occur, or there may be symptoms of impending lung-mischief. All these conditions are rapidly and easily remedied by the administration of mercury. After they have passed away, the patient may remain well for several years before the gummata which characterises the tertiary stage begin to appear.

It was formerly thought that all syphilitic affections of the *nervous system* came late in the disease, and were distinctly of the tertiary class. We now know that this is to a large extent an error, and that it is not at all infrequent for patients to suffer from implication of the cerebro-spinal system in comparatively early stages. Alfred Fournier has described a very peculiar form of general analgesia, which is not uncommon coincidently with the eruption, and the ophthal-

moscope has demonstrated the existence of retinitis in many instances soon after or even before the end of the first year.

TERTIARY SYMPTOMS—The division of syphilis into stages is to some extent arbitrary, but for the most part it accords fairly well with clinical observations, and no one can doubt that it is practically convenient. The specification of the primary symptoms is easy, and all will admit that they, at any rate, do not (with rare exceptions) recur after disappearance, or mix themselves up with the later stages. So also of the secondary symptoms. Every one recognises a copious, symmetrical, copper-tinted eruption, and symmetrical superficial ulcers in the tonsils, as characteristic of an early period, and, as a rule, not in the least likely ever to re-appear in the same form if once they have completely disappeared. If a good interval of immunity has occurred, they will certainly not re-appear, but early recurrences are not so infrequent as in the instance of the primary symptoms. Although, in the present day, with the all but universal employment of mercury, we but seldom have the opportunity of witnessing spontaneous disappearance, yet we may feel certain that, like the primary stage, the secondary one has its limits of duration, and vanishes after a time spontaneously. In the stage which we are now about to consider, no such tendency to spontaneous cure is observed, and unless the physician intervenes with his remedies, the morbid processes, once initiated, continue to progress. Certainly, we have here a very important and quite natural feature of difference between the secondary and tertiary forms of disease. When we add that the tertiary are, as a rule, ranged without symmetry when multiple, that they are often few in number, or even single, and that we frequently observe them after an interval of immunity extending over many years, it will be yet more clear that they constitute a separate group. We make no distinction as to the tissues affected, asserting that all the tissues, or any single tissue, may suffer in either of the stages. It is not a question of the tissue attacked, but of the peculiar types assumed by the morbid process, which constitutes the difference.

As regards the stage which the writer has ventured to name intermediate, it is far less easy to separate it on the one hand from the secondary, and on the other from the tertiary. As its name implies, it stands between the two, and it partakes of the nature of both. Its phenomena are some-

times symmetrical, at other times not so, some of them disappear without specific treatment, though most of them, probably, do not. This stage may begin before the secondary is well over, and may be prolonged until that which is definitely tertiary begins. If it were practicable to use inoculation experiments as a test of stage, we might, perhaps, be able to distinguish definitely. In the primary stage, the local lesion is alone capable of conveying the contagion to another person; in the secondary stage, the blood and all fluid tissue-elements contain the virus, whilst, in the tertiary stage, contagion is probably not possible. The precise date at which the blood ceases to be the vehicle of contagion might be claimed as the end of the secondary stage. In most persons, probably, it occurs between the end of the first year and the second. In some it may be much later. Thus, then, we have clear rational data for the division of the stages. In the primary stage, syphilis is for a short time a local disease; then, in the secondary, it is a universal, or blood and tissue malady; and finally, in the tertiary, it is a disease of tissues but not of blood, and its manifestations are irregular, in most cases absent; and when they occur they are—in a strong, if not an absolute, sense of the words—local only.

We must again, and always, be on our guard against observations possibly made erroneous by the fact that we study syphilis as modified by mercury, not in its spontaneous development.

The conditions just mentioned as some of those which are most frequent in the intermediate stage, are obviously, some of them, the same in name as those which we witness in the secondary period, whilst others are those which might have been expected later on. They are, however, usually different in certain features from their homologues in the other stages. The erythematous ringed eruption, for instance, is never exactly repeated in any other period. The peeling patches in the palms are more superficial, much fewer in number, and slower in development than the psoriasis which sometimes, in the secondary stage, affects the same parts. Everything in this stage is feebler in type, less acute than in the secondary, whilst there is much greater proneness to wide diffusion or multiplicity than in the tertiary.

A few words must here be said respecting certain cases, in which the secondary and tertiary stages are reputed to run into one another, or in which the disease de-

velops itself so rapidly that they are not to be distinguished. Rightly classified, these are, probably, simply cases in which the specific is not successful, and the secondary stage is, therefore, persistent and severe. The disease remains throughout generalised, never assuming the more distinctive local peculiarities of the tertiary stage. We must not count severity of local processes, that is, tendency to suppurate or to ulcerate deeply, as being a peculiarity of any one stage. It may occur at any period if the treatment fails to cure the malady. The treatment, which is almost always successful in these cases, confirms this view as to their nature. If we enable the patient to bear mercury, by sending him to the country or to the seaside, we usually succeed in curing the disease, but the liability to true tertiary symptoms after a long interval will come just as in other cases.

The true tertiary symptoms are those to which a syphilitic patient may become liable five to ten, or even twenty years after his disease, and after, it may be, a long period of good health. We shall find that they are mostly of the nature of gummata, and that they all possess the peculiar feature of tendency to local spreading to which, when it shows itself in the skin, the term *serpiginous* is given. All of them, when they recede, leave a state of sclerotic atrophy, or, in a few instances, of hypertrophy, of the part involved. In almost all we see good reason to believe that, in addition to the syphilitic taint, some localising influence takes an important share in evoking the local changes. If we attempt to enumerate some of the chief, they are the following:—

Chronic and relapsing periostitis, leading to osseous nodes or sclerotic hypertrophy, but if neglected to suppuration and necrosis.

Muscular nodes, or gummata in the substance of muscles, which often, by their absence of inflammation and comparatively slow growth, simulate tumours.

Gummata in viscera, liver, testis, lung, &c., slow in progress, as just noted in the case of muscles.

Gummata in fibrous structures, and in cellular tissues. The meninges of the brain and spinal cord, the capsules of joints, and the subcutaneous cellular tissue generally, are the parts most likely to be affected.

Diseases of the skin of a lupoid type, gummatous or tubercular in commencement, serpiginous, and leaving scars.

Diseases of the tongue of a gummatous or simply inflammatory form; in either case leading to sclerosis.

These affections are so much influenced by the habit of smoking, that it is often quite impossible to say how much is due to the one and how much to the other cause. Superficial sclerotic hypertrophy is a not infrequent result; but as regards this condition and several others formerly supposed to be due to syphilis only, it is unquestionable that precisely similar ones may result from smoking only.

Aggressive structural disorders of the ganglionic, conductive, or central parts of the nervous system, leading to such affections as—

Ataxy and its complications.

Ophthalmoplegia externa.

Ophthalmoplegia interna.

General paralysis of the insane.

Amaurosis from optic atrophy, with various complications.

Paralysis of special nerves (the fifth, the facial, &c.).

In most of these there is not, at any stage, evidence of active inflammation, nor is there any proof of deposit or growth which might deserve the name of gumma. No doubt, a very chronic and slightly effusive form of inflammation is at first present, but it gives place quickly to atrophic changes. There is every reason to believe that the initial disease is *serpiginous* or locally infectious, for we find it slowly spreading to adjacent parts unless arrested by treatment. Excepting in their early stages, these affections are not usually much influenced by specific treatment.

Conditions implying general tendency to tissue-degeneration, such as amyloid disease.

Chronic inflammations of mucous membranes in certain regions, attended by thickening and ulceration. These occur especially in the rectum and pharynx, mouth, and female genitals (*esthiomène*).

The influence of specifics in the treatment of tertiary affections is variable and uncertain. Sometimes, as in the case of large gummata of the tongue or of muscle, the influence is shown very quickly, and a cure is easy. This, however, is by no means the case in many of the other tertiary affections. Some of them progress steadily in spite of treatment, or relapse very speedily when it is suspended. In many a distinctly beneficial influence is secured, but nothing like a cure can be obtained. Especially is the last statement true concerning many of the affections of the nervous system, which are remotely connected with syphilitic taint. Thus, the

non-success of treatment can by no means be accepted as conclusive in regard to diagnosis.

Many disorders are in association with a distant taint of syphilis, which yet do not respond definitely either to iodide of potassium or mercury. In nearly all cases, however, these remedies do some good, and it may easily be the fact that they are often laid aside just when decided benefit was about to accrue. A careful study of the therapeutics of lupoid affections of the skin, due to syphilis, will probably much help our conceptions of what takes place in parts which are hidden from our view. Syphilitic lupus very often does not get well under iodide of potassium, but vanishes at once when mercury is pushed. Very often, indeed, it gets almost well under one or the other of these drugs, and the patient, satisfied with the result, leaves off treatment before the cure is absolute. If the least portion of lupus-structure be left, from it the process will again spread. On the other hand, if the patch be quite well, and nothing but healthy scar left, then it is very rare to witness any relapse. In proof of the resistance of this malady to specifics, the fact may be adduced that many cases, in spite of treatment under different surgeons, last half a patient's lifetime. We have but to apply this experience of the power of resistance of syphilitic cell-growths in the skin, to the nervous system, and we shall understand why such maladies as ataxy and ophthalmoplegia often prove intractable. Iodide of potassium, given in sufficient doses, is usually very efficient in the cure of tertiary affections of all kinds. In some respects and in some cases it seems even more useful than mercury. In many instances, however, it depresses so much that its use must be abandoned, and in all such mercury usually succeeds. Whenever a case resists the iodide, and whenever it is important to obtain a rapid result, the two should be combined.

The prognosis of tertiary disease depends wholly upon the success or otherwise of our treatment. In their own nature, all affections of this class are progressive, and show no tendency to spontaneous amelioration. Even when much helped by specifics, there is a great risk of relapse. In many cases, however, when once a complete local cure is obtained, no relapse whatever occurs, and the patient will remain well for many years. In former times, before the introduction of the iodide of potassium, and when we knew less as regards the best methods of using mercury, many cases of tertiary disease ended fatally.

It will be understood, from what has been advanced, that the diagnosis of tertiary syphilis is beset with difficulties. In many cases it is very easy, and in many the sources of fallacy are such that they cannot be wholly avoided. As in the earlier stages, we still find the disease playing the part of an imitator. The form of ataxy which occurs to the syphilitic, and which is in part at least due to their former syphilis, is usually closely similar to ataxy when due to other causes. Many cases of syphilitic lupus are exactly like common lupus, and so of most of the other affections. Without here going into any detail as regards the diagnosis of special affections, it may be said in general that suspicion should be aroused whenever a malady is irregular in its development and course. The syphilitic simulations are seldom quite perfect, and they often develop in a more rapid manner than do their prototypes. In all such cases the history must be carefully inquired into, and upon it the diagnosis must in many cases rest.

Treatment.—Many questions of treatment have already been discussed in the preceding pages, but the subject is so important that, at the risk of repetition, it may be well to recapitulate and enlarge upon it. The treatment of syphilis has in recent years almost narrowed itself down to the judicious use of two specifics. When we have constructed sound rules for the administration of the iodide of potassium and of mercury, our task is almost done. In former times, various vegetable specifics enjoyed a certain amount of repute. The discovery of the iodide of potassium, and the assignment of its place as the adjuvant of mercury, has, however, so fully reinforced the latter drug that we now but seldom hear mention of any other remedies. It is, precisely, in the cases in which mercury either fails to cure or definitely disagrees that the iodide is efficient, and few indeed are those which the judicious use of one or the other, or of a combination, will not conduct to a satisfactory conclusion.

Some general rules may be offered for guidance in the employment of these important drugs.

In the early stages of syphilis the iodide of potassium is comparatively powerless, and mercury should be used. Thus, the induration of a primary sore will resist the influence of the former, but melts away at once when mercury is given. So also of the secondary phenomena, all of which, excepting perhaps sore-throat and sores in the

mouth, are best treated by mercury. The later the manifestation, the longer the period since the primary symptoms, the greater the probability that the iodides will prove efficient. Thus, against all forms of tertiary gummata, whether in muscles, in cellular tissue, or in glands, the influence of the iodide is usually shown in the most rapid and definite manner. A lump in the tongue, in the testis, or in a muscle, will often be absorbed under the iodide with a speed not less remarkable than the disappearance of a large primary induration under mercury. Nor does the precise stage of the gumma appear to make much difference, for the specific power of the drug is shown just as clearly against an open ulcer as against a deeply placed infiltration. From this assertion of the efficiency of the iodide against all tertiary symptoms, it must not be assumed that mercury is not useful in them, nor even that, in many such cases, it is not the better of the two. With some, however, it certainly does not agree; a fact which was abundantly proved by the frequent intractability of tertiary syphilis, in the times before the iodide was known.

In forming a comparative estimate of the value of these two drugs, attention must be given not only to the stage of the disease, but to the dose of the remedy and the idiosyncrasy of the patient. The iodide has certainly during the last ten years lost some of the repute which it enjoyed, and mercury has correspondingly gained. This gradual change of opinion has been coincident with the employment of mercury in much smaller doses than formerly, and its combination with tonics. In a great number of patients mercury, if the dose be but small enough, seems itself to act as a tonic, and careful observations have proved that not only does it favour depuration by the glandular system, but that it actually increases the number of red corpuscles in the blood. Everything depends upon the dose. Instances of idiosyncrasy are not very common in the case of mercury; but we do occasionally meet with patients in whom the smallest doses disagree, and, conversely, with others who take very large doses for long periods with but little appreciable effect. With regard to the iodide, idiosyncrasy plays a much more important part. Many persons cannot take ordinary doses without poisonous effects; many more, who can take them, yet experience under their curative influence, as regards the malady, a degree of depression of nerve-tone which causes real distress. Whilst, in the case of mercury, tolerance is seldom much increased by

habit, the reverse is the fact as to the iodide. With the latter, in almost all persons, without regard to idiosyncrasy in the first instance, it is possible, by gradual additions, to obtain at length tolerance for large doses. It is one of those drugs respecting which the curious statement is true, that the dose does not much matter. We often get as good effects from small doses as from large, and the most severe examples of poisoning have usually been from very small ones. The writer has known patients cured in the most definite manner by doses of less than a single grain, and, on the other hand, a patient has taken, on his own prescription, more than an ounce and a half in the day. If a patient has become tolerant and his symptoms do not yield, it is often wise to increase the dose freely; but, as a rule, it may be doubted whether the very largest ones, now or recently in fashion, do anything more than might be effected by much more moderate quantities.

The fear of causing absorption of the *mammæ* or *testes* by the prolonged use of iodides exercises but little influence on the minds of modern prescribers. Although, however, these results are very infrequent, yet it must be fully recognised that the iodide does often depress the sexual function very definitely whilst it is in use, and possibly in some instances does permanent injury to it. Many persons become low-spirited and miserable whenever they take it.

With many prescribers, and especially in France, the iodides of mercury enjoy much favour. There can be no doubt that they are exceedingly efficient, but they are for the most part more irregular in their action, more liable to gripe and purge or even to salivate unexpectedly, than are most of the uncombined preparations of either of their components. It may also be doubted whether their combined salts are in the least more efficient than the simpler preparations, which have the advantage of less variability in effect. Those who aim at simplicity of prescription may therefore, without any risk of loss to their patients, well be content to learn the details of the use of mercury and the iodide of potassium severally or together, and may venture to pass by their combined salts. It would be most tedious to attempt to describe the modes of use of the latter; and, as their doses, &c., may be found in all prescribers' manuals, further reference to them will be omitted.

Mercury may be used in many different ways, and so efficient is it in all that each

one has its warm advocates. All that is needful is that it shall be got into the blood and brought into contact with the tissues; and any method, which does this without material interference with the patient's health or disturbance of his digestive functions, is satisfactory. Perhaps we ought, in these respects, to give the palm to those methods—inunction and fumigation—which introduce the drug by absorption through the skin. They are certainly less liable to be followed by purging than when it is given by the mouth. Here, however, their advantages probably end. It may well be doubted whether the claim put forward by their respective advocates, that they are more definitely curative, is borne out by facts. On the other hand, it is very easy to give mercury by the mouth in such a manner that it shall not in the least interfere with the stomach, and this method of treatment is in most instances much less inconvenient to the patient. The writer may confess that, after plentiful opportunities for the observation of different methods, he has adopted the practice of keeping the skin methods in reserve for exceptional cases, and under all ordinary circumstances administers the remedy by the mouth. One simple rule appears to be the key to success. It is to give small doses frequently repeated, and never large ones.

Hydrargyrum cum cretâ is, perhaps, the most constant and least variable of all preparations. It may be made into pills of one grain, in combination with one grain of Dover's powder if necessary, and of these the patient may take one every six, four, three, or even two hours, according to circumstances. Usually, one pill four times a day will suffice to clear away a chancre or a secondary eruption as rapidly and as completely as can be wished. In some cases, it may be more convenient to double the dose than to increase the frequency of administration, but the latter, if the patient is willing, is the better plan. If ptyalism should occur with such doses, it will certainly be mild and easily controlled. As a rule, however, all the symptoms of syphilis may be got rid of without any affection of the gums. If such affection should occur, it usually implies the full physiological influence of the drug, and a very rapid subsidence of symptoms may be simultaneously expected.

During a mercurial course, fruit, green vegetables, coffee, all aperients, and for the most part all stimulants, should be forbidden. The patient should carefully wash his teeth and gums twice in the day,

and it will be better that he should not smoke. All irritation of the mouth by smoking increases the risk of mucous patches, and tends to make sores in the throat more difficult to cure. The reason for abstinence from coffee, fruit, &c., is the risk of their causing diarrhœa. A patient, taking the remedy in the form and doses just indicated, may go to business as usual, and is in no particular risk of taking cold. If he is much out in the fresh air, he must expect some delay in the influence of the specific, and be prepared to require larger doses. In like manner, all tonics—quinine, iron, &c.—enable the system to resist mercury, and should be used only when really necessary. If a patient be kept in bed and on rather low diet, he will yield much more quickly to mercurial influence, and ptyalism may be induced, under such conditions, with half the doses required in one who is about in the fresh air.

As regards the production of ptyalism in the treatment of syphilis, we may say that, although often the most rapid disappearance of symptoms takes place when it occurs, it is certainly to be avoided. If it is profuse, and necessitates the suspension of the remedy, the latter should be used again in smaller quantities as soon as the mouth has recovered. Some of the most severe outbreaks that we ever witness occur to those who have been rapidly cured by a short ptyalism in an early stage, and have then left off the remedy. It is especially under such conditions that rupia is prone to occur.

If mercury be given for an indurated chancre in the manner indicated, it may probably require about a month to get rid of all hardness, but the period varies much in different persons, and perhaps also in relation with the stage at which it is commenced. If it is begun before any secondary symptoms have shown themselves, it is very common for them not to appear at all, or, at most, only in the very slightest form. Sores in the throat are the phenomena least frequently omitted. It is, probably, quite the rule for the skin to escape. If, however, at any period within six months the mercury be suspended, then, within a few weeks of the suspension, a rash may show itself. Such rashes, when they occur, however, are always mild, and their mildness seems proportional to the length of time during which the mercury has been administered.

As yet no statistics have been collected which would enable us to speak, with any confidence, as to the relative efficiency of

different methods of treatment in preventing relapses. We do not know, with any certainty, whether those who have been freely salivated are less prone to relapse than those who have taken such small doses that they have never felt their effects in any other way than the disappearance of symptoms. This remark as to relapses of secondary phenomena applies also to tertiary symptoms. We believe, and probably on good grounds, that those who have taken mercury freely and for long periods, in the early stages of the disease, are less liable than others to the subsequent development of tertiary symptoms; but it must be admitted that proof is wanting. With the prevailing unanimity of opinion in reference to mercury, it is very difficult to get cases for observation in which it has been omitted. Syphilis is in its nature so variable, that it is unsafe to assume that what a few cases appear to teach is really the fact. There can be no doubt that very often we meet with severe tertiary symptoms in those who, from the history given, appear to have had very short or irregular treatment in the first instance. Unfortunately, however, there are some cases on the other side which show persistently recurring reminders, and even severe tertiaries, after specific treatment of the most careful and prolonged kind. As a general rule, mercurial cures in the secondary stage stand good, and a large majority of our patients know nothing more of their disease. But there are exceptions, and these probably occur after all the various modes of administration.

If we are allowed to estimate relative efficiency by the rate of disappearance of the phenomena, then it is probably true that the internal use of grey powder in small doses, frequently repeated, is just as useful as either inunction or fumigation.

To the credit of the method by small doses frequently given, it is to be clearly and strongly stated that patients usually improve in health under them. If purgation be avoided, the patient will often enjoy improved appetite and digestion, and may gain in weight and colour. At the end of a six or nine months' course, he may allege that he never was in better health. Those who have before suffered from constipation and liability to headache, may get quite rid of these troubles and may continue permanently free. In women who have suffered from painful menstruation, the mercurial course may prove a complete cure. These clinical facts, which are matters of frequent observation to specialists in syphilis, are so

definite that they are well worthy the attention of the general physician. It is well known that many distinguished therapeutists have become enamoured of mercury for various chronic ailments, such as scrofula and some forms of dyspepsia, as well as for those in which the liver is more especially concerned. Experience in respect to syphilis would go to show that the drug may be used without any fear of loss to general health, if employed in the way suggested. On the other hand, there is no doubt that severe forms of cachexia and debility may be induced by the irregular and excessive administration of this potent drug.

As regards its mode of influence in syphilis, we may reasonably suppose that it is requisite that it should be brought into contact with the cell-elements concerned in the morbid process. Wherever its local application is practicable, we know that it is usually very efficient. Administration through the blood is necessary only when the disease is generalised, as in the secondary stage, or when its manifestations occur in parts which are not accessible. In a general way, it is well to combine local with internal use. For the primary sore, an efficient dressing with the black wash unquestionably expedites the healing and the disappearance of induration, and so also of the secondary eruption, the removal of which is materially helped by the inunction of a mercurial ointment. For this latter purpose, the ammonio-chloride, in the proportion of fifteen grains to the ounce of lard, is very convenient. Its use is especially desirable when the eruption affects the face and hands, and its early removal becomes a matter strongly desired.

The remarks, just made, may fitly introduce more detailed statements as to the efficiency of local treatment, in all cases in which the disease has passed the secondary stage. Very remarkable instances of this are not infrequently seen. Cases, in which the internal use of specifics has been long continued with only very partial benefit, may be cured very quickly by local measures. Not only may they be cured, but the cure may be a permanent one, and thus a very strong argument is afforded in favour of the essentially local character of such phenomena. Respecting all forms of syphilitic phagedæna in the tertiary stage this is well known. Although the administration of the iodides, or even of mercury, is usually very useful, yet by iodoform, or by cauterisation with the acid nitrate of mercury, the cure may be accomplished in a fifth of the time. So also, syphilitic palmar psoriasis

and syphilitic serpiginous diseases of lupoid type are best treated locally. An ointment, containing one drachm of iodoform to the ounce of lard, if liberally used, will often effect an unaided and rapid cure in such cases. To many it is unquestionably more efficient than any of its competitors. In all syphilitic skin-diseases in the tertiary stage, whether ulcers or new-growths, its use, if the patient will permit it, should never be omitted. That it is not necessary to use a specific is, however, fully proved by the efficiency of caustic applications for the same purpose. A single free application of the acid nitrate of mercury may be sufficient to permanently cure a patch of syphilitic lupus, which had resisted much internal treatment. It would appear that the cell-organisms of such growths possess but feeble vitality, although persistently infectious, and are thus easily killed by any caustic. The point is to destroy every portion, for, if the smallest particle be left behind, it will suffice to reproduce the malady. From what we see of the efficiency of specific applications and internal treatment, in the case of serpiginous affections of the skin, it is probably fair to infer as to their power in diseases of internal parts and especially of the nervous system. If in the former we stop short of a complete cure, the morbid process will be relighted, and a relapse will follow; but if the local cure be perfect, then it will probably be permanent. In this way may probably be explained the frequent disappointments in reference to disease in hidden parts. We do not push the treatment far enough.

After what has been just said, it is clearly impossible to lay down any rules as to the duration of an antisiphilitic treatment. It will depend upon the method employed and the effects produced. If the case be one of primary or early secondary syphilis, and the treatment adopted be that by small doses of mercury without ptyalism, a six months' course will probably be sufficient. During the last four of this period, the patient may probably have been quite free from symptoms. Even after this long course, we must be prepared, in a certain number of cases, to see a symmetrical eruption produced within a few weeks after the suspension of the drug. This rash will probably be an erythema of a very mild kind, and will disappear promptly when the remedy is resumed. Unless some symptoms should show themselves, there is probably no good reason for again resorting to specifics. If the patient be married or intending to marry, it may be wise to con-

tinue mercury for a much longer period, with or without brief omissions. Some good authorities advocate short intermittent periods of administration, and no doubt excellent results may be so obtained. On the small dose system, however, there seems but little reason for ever suspending it until it seems wise to wholly desist.

It may be convenient to introduce here a few details as to the different methods of using mercury for the cure of syphilis. The inunction method is one of old repute and still largely used on the Continent. It gives to Aix-la-Chapelle the reputation which brings to it crowds of patients. At this place, where the details are so well understood, it is customary to have the ointment rubbed in by trained attendants. These men occupy from twenty minutes to half an hour at each friction, and use about half a drachm of the strong mercurial ointment. Everything that is done at Aix can be done equally well at the patient's home. All that is necessary is, that he should give himself up to the treatment and observe proper precautions. The ointment should be rubbed into different places on successive days, so as to avoid the production of eczematous irritation. Generally, it is best borne on the sides of the chest and abdomen, but the inner sides of the arms and thighs are also convenient positions. After the rubbing, the patient should put on a flannel gown and go to bed without washing. In the morning a warm bath may be taken. At Aix, a course of rubbing lasts usually one month, the quantity used and the frequency being modified according to the effects produced. It is usual to advise patients to return after a few months for another course, in order to complete the cure. Excellent results are usually obtained in this way, and not infrequently patients are cured, whose symptoms had been very difficult to deal with under other methods. The explanation of these is, however, usually this, that the other methods had never had a fair chance, owing either to the patient's irregularity in their use, or inattention to diet and exposure to cold. It may be alleged for the inunction plan that it is less likely to disagree, by causing colic or purging, than the internal administration, and that it is very certain in its effects. It may, with good reason, be doubted whether it has any other recommendations, and more especially whether the claim put forward that its cures are more permanent than others is well founded.

At several Continental watering-places of repute for the treatment of syphilis,

popular attention is fixed upon the use of warm sulphur baths quite as much as upon the mercurial rubbing. There is no reason, however, to believe that these exercise any share in the cure. See INUNCTION OF MERCURY.

Another endermic method of administration is by the fumigation bath. This plan was perfected by the late Mr. Langston Parker of Birmingham, and has been very successfully employed by Mr. Henry Lee and others. Calomel is the form of mercury now usually employed. It should be specially prepared and of great purity. The patient is made to sit over a lamp upon which the calomel, in quantity of from a scruple to half a drachm, has been placed. The calomel is sublimed by heat in company with watery vapour, and is deposited on the patient's skin. When the process is completed, the patient is made to wrap himself in a flannel gown, and without any washing or drying to go at once to bed.

This method has the same advantages as that by inunction, and is exceedingly efficient. The two share in the disadvantage of being much more troublesome than administration by the mouth, and although less liable to purge, they are at least equally prone to cause unexpected salivation.

Hypodermic injection has come but little into employment in English practice, nor does it appear to increase in favour with those Continental surgeons who at one time thought highly of it. Mr. Astley Bloxam, at the Lock Hospital, employs it largely, and considers it, on the whole, the most efficient and least troublesome of all methods. Inasmuch as the surgeon administers the dose himself, he has the fullest control over its employment. Mr. Bloxam has, in verbal communication with the writer, insisted on the following precautions:—

In order to prevent irritation and abscess, the injection should be made into muscle and not into cellular tissue. The needle should always be washed after the syringe has been charged, so that none of the fluid may touch the skin during introduction. It is sufficient to inject a third of a grain of the bichloride of mercury dissolved in twenty drops of water, once a week. Three such injections, made on consecutive days, will usually salivate freely, thus proving the efficiency of the method. The gluteus maximus is the most convenient muscle for the purpose. The solution should always be freshly made when wanted.

Some important memoranda may be offered as to the use of the iodide of potassium and other iodides.

In some cases the iodide of sodium depresses less than the potassium salt, and acts as efficiently. It is a very good practice to combine the three iodides—sodium, potassium, and ammonium—in the same prescription. Whether given singly or in combination, some free ammonia, preferably sal volatile, should always be added. It always increases the efficiency of the iodide salt. It is never well to begin with a large dose of an iodide. Small ones are, in the first instance, just as efficient as larger ones, and it is often a great point to go on increasing them. Doses of two or three grains will often, at first, do as much as those of ten or more. Every week, if the cure is not progressing rapidly, two grains should be added to the dose.

Coryza is the commonest of all symptoms due to the iodide when it disagrees. It may be very profuse at first, but usually lasts only for a short time. In other cases, the patient may suffer from a chronic cold in the head so long as he continues the drug. When this is the case, there is generally definite depression of tone as well, and the surgeon will do wisely to try whether he cannot effect the cure better by small doses of mercury.

The skin-eruptions which may be produced by the iodide are very various in their characters. They are certainly due to idiosyncrasy, and have little or no relation to the dose employed. They usually develop very quickly, and sometimes with great severity after two or three doses. When once an eruption is produced, we seldom witness any tendency to disappearance, so long as the drug is continued. Usually, the eruption becomes aggravated both in amount and character. A form of acne is the commonest type of iodide-eruption, but hæmorrhages, erythemata, and vesicular and bullous eruptions may occur. Now and then we witness the formation of large bossy wheals, which may develop to a very great size. Some of these eruptions may closely resemble, to the inexperienced eye, syphilitic eruptions, and thus the remedy may be further pushed in the hope of curing that which it is itself producing. In such cases, occasionally a fatal event by exhaustion may be brought about. When eruptions occur, either reduction of dose or disuse of the drug is usually definitely indicated.

Most patients bear the iodides best when in vigorous health, and, in the stage in which they are needed (the tertiary), it is generally wise to employ tonics and fresh air freely. Arsenic has repute as tending

to prevent eruptions, and many persons will bear full doses when enjoying the advantage of sea air, who are much depressed by them under other conditions.

An extempore combination of the bichloride of mercury with the iodide of potassium enjoys a high repute in English practice. In doses of one drachm of the Pharmacopœia solution of the bichloride ($=\frac{1}{16}$ th of a grain), with four or five grains of the iodide, and half a drachm of sal volatile, a very efficient compound is obtained, which seldom disagrees.

It may be well to mention, in relation to special measures of treatment, certain peculiar symptoms and conditions which may need special rules.

Ulcers in the Throat and Sores in the Mouth in the Secondary stage.—Give mercury, use black wash as a gargle, or dust the sores with iodoform. If they prove intractable, touch them lightly with the acid nitrate of mercury or some other caustic. If very painful, it is necessary to consider whether they may not be aggravated by mercury, especially if the latter has been long used. If this appears probable, mercury must be disused, and the iodide of potassium given. Smoking must always be prohibited.

Ulcers in the Throat in the Intermediate or Tertiary stages.—These are often phagedænic. Iodide of potassium must be freely given, and iodoform applied by insufflation, or by means of a camel's-hair pencil. If, in exceptional cases, the condition persists, the sore must be freely touched with the acid nitrate of mercury. It is a rapidly destructive condition, and the treatment must be efficient. There is usually no objection to small doses of mercury, but the iodide will generally suffice.

Iritis, Retinitis, Neuritis, &c., in Secondary stage.—Push mercury rapidly to slight ptyalism, and in iritis use atropine very freely. Large doses of iodide of potassium will usually suffice for these affections, but mercury is better.

Ulcerating Secondary Eruptions of the Rupial type.—These usually occur after mercury has been given in too large doses, has disagreed, and been wholly laid aside for some time. Mercury, in combination with the iodide of potassium, is indicated, or mercury may be given alone. The iodide alone is rarely sufficient. Ptyalism is to be carefully avoided, and, if success is not soon obtained by other methods, inunction or fumigation should be resorted to. Sea air is often very valuable. When

once the cure sets in, it usually progresses well, and is in the end complete. Iodoform ointment should be used to all sores.

Phagedæna in all forms and stages.—Iodoform is by far the most convenient, least painful, and most efficient agent. It will probably supersede all the older methods. Should it not succeed, constant immersion, the acid nitrate of mercury, or the actual cautery, may be employed. Mercury and the iodide should be given with opium. If all fail, the patient must be at once sent to the seaside, and the same remedies used there.

Disease of Arteries (indicated by Cerebral Attacks).—A long course of small doses of mercury or, less efficient, of the iodide.

Periostitis and all forms of Bone-affection.—Here the iodide of potassium is most efficient, and relieves pain more quickly than anything else. If the case resists, however, mercury should be used, and it will often succeed in removing hard nodes which the iodide had failed to influence.

Periostitis and Bone-affections in the Inherited Disease.—The same remedies must be used, but much less rapid results are to be expected. Very often nodes in this connection resist treatment for some time, and then suddenly disappear.

Lupoid Affections of Skin in Tertiary stage.—Rub in iodoform ointment, and apply it on lint; or, if the part be one to which this cannot be conveniently used, or the smell be an objection, apply the acid nitrate of mercury freely. Iodide of potassium may be given, but, if not successful, it should at once be substituted by mercury, which often succeeds when the iodide fails.

Phagedænic Lupus of Nose and Face from Inherited Syphilis.—The destruction may be very rapid, and the treatment must be prompt. Cauterise freely with acid nitrate, and then dress with iodoform ointment. Give iodide and bark.

Interstitial Keratitis of Inherited Syphilis.—Give a long course of small doses of mercury with bark. Send patient to sea or country during the treatment. Use atropine or belladonna fomentations.

Locomotor Ataxy or other Chronic and Aggressive Nerve-disease with Syphilitic Antecedents.—Give mercury in small doses to slight ptyalism. If benefit results, repeat the treatment after a month's interval, or give smaller doses without ptyalism over a period of six months or a year. Many such cases relapse, and need a repetition of treatment. Inunction is very useful, but

not more so than small doses by the stomach. Iodide of potassium is also very efficient, but probably less so than mercury.

In cases which resist mercury, and in which it is wished to induce ptyalism rapidly, use the hypodermic method, employing a third of a grain every day for three or four days. Or use mercury by the mouth or inunction, or insist that the patient shall keep his bed.

In cases of pregnancy in which it is desired to protect the fœtus, administer small doses of mercury (one grain of grey powder, or one drachm of the solution of

bichloride three times a day), through the whole period. There is possibly an objection to this, that it may damage the child's teeth (first set), but upon this point careful observation is necessary.

In cases in which marriage is in prospect, let the patient take small doses of mercury continuously during the whole period before marriage. Abstain from the iodide. However efficient and long-continued the treatment, no one should marry until two full years have passed from the beginning of the disease.

JONATHAN HUTCHINSON.

T

TAGLIACOTIAN OPERATION. *See* RHINOPLASTY.

TALIPES. *See* CLUB-FOOT.

TAPPING. *See* PARACENTESIS.

TARSAL BONES, Caries of the.—The frequency of this disease is well known. The persistent way in which it follows on relatively slight injuries—e.g. sprains, slipping on the kerb, blows from a stone, jumping off a wall—may perhaps be accounted for by the delicate cancellous tissue of which the bones so largely consist, their intimate relation with complicated synovial membranes, the comparatively scanty blood-supply to the dorsum of the foot, its frequently lowered temperature, and the want of rest.

The diagnosis of caries will be spoken of when the chief sites of the disease are considered; but it may be stated here that the early recognition of the disease is of the utmost importance, for so long as the caries is limited to one bone, it will be possible to save a very useful foot.

The chief sites of caries of the foot from behind forwards are: (1) Os calcis; (2) ankle-joint; (3) astragalus; (4) scaphoid, and along with this, on account of the complicated synovial membrane in the middle of the foot, other bones—e.g. cuneiform, astragalus, and the bases of the metatarsal bones—are too often affected; (5) cuboid.

OS CALCIS.—It is important to remember that caries remains limited to one bone much longer in some of the above than in others, and in none longer than in some cases of caries of the os calcis. This may be present, originally, in three different

sites: (a) Caries of the body of the bone; (β) caries of the astragalo-calcanean joint, which may begin as a primary affection after a severe twist or sprain of the ankle, or may be secondary by extension from the body of the os calcis or from the under surface of the astragalus; (γ) caries at the back of the os calcis between the body of the bone and the posterior epiphysis—an epiphysis which does not appear till the tenth year, and which does not unite with the body of the bone until the fifteenth to the nineteenth years.

Diagnosis.—The thickening is limited to the neighbourhood of the heel, where the swelling obliterates the natural sulci on either side; the sinuses are met with chiefly posteriorly, but may form as far forward as the calcaneo-cuboid joint, corresponding then to a point midway between the external malleolus and the base of the fifth metatarsal bone.

It will be pointed out, later on, that in disease of the ankle-joint, astragalus, &c., not uncommonly a probe can be passed across the instep beneath the soft parts, from sinuses on one or both sides. This is not the case with disease of the os calcis, but, in some severe cases of disease of the calcaneo-astragaloid joint, a probe can be passed across the heel through this joint. The movements of the ankle-joint will be found free and painless, an anæsthetic being given to a child if needful. Where calcaneo-astragaloid disease begins primarily, its diagnosis is a matter of more difficulty. The position of the swelling and sinuses may here approximate to those met with in disease of the astragalus or ankle-joint; the pain is

greater than in disease of the body of the os calcis, and the foot is sooner disabled. By the aid of an anæsthetic the ankle-joint will be found free, and probes, introduced by sinuses, may pass towards the upper surface of the os calcis, the level of which is known by its being on a line with the bony projection for the origin of the extensor brevis digitorum. Occasionally, as already stated, a probe may pass across the heel through this joint.

Disease between the epiphysis and body of the bone may be detected, not only by the position of the sinuses and swelling, but also by the age of the patient, and by the fact that, owing to the insertion of the tendo Achillis into this epiphysis, pain will be complained of and impairment of movement noticed, when the patient is asked to throw the tendon into action by raising the heel or rising on to the toes.

Treatment.—The surgeon, in deciding between (a) expectant treatment and (β) operative measures, either partial—e.g. exploring and gouging—or complete removal of the bone, will be led by the following considerations. If the patient is in fair health, if the viscera (especially the lungs) are sound, if the patient is in a fitting position to secure unbroken rest, constant attention, good food and air; if no sinuses have formed, or if the sinus be single and healthy-looking, if the origin of the disease be distinctly traumatic, then, under the above circumstances, expectant treatment is fully justified. But if, on the other hand, the subject of the disease be ‘etiolated,’ have been subject from infancy upwards to bad air, food, poor hygiene of every kind, if from the rank of life it is important to save time for schooling, apprenticeship, &c., then operative measures without further delay are as clearly indicated. These do not necessarily mean removal of the whole bone, an operation which, while it leaves a very useful foot, leaves also a very ugly one. In any case, the condition of the bone is best explored from its outer side, which has few important structures in relation to it.

An anæsthetic being given and the parts rendered bloodless by Esmarch’s bandages, incisions are made which are modifications of those for removal of the entire bone. Thus, by making on the outer surface of the os calcis, on a level with its upper surface, a horizontal incision commencing at a point midway between the external malleolus and the base of the fifth metatarsal bone, and ending just outside the tendo Achillis, joined by a second incision at right angles to the anterior extremity of the first, as far as

the sole but not encroaching upon it, a sufficient flap can be turned down for exploration of the bone. Now, if steel probes passed into any sinuses which may exist do not pass far into the bone, if the bone around them is hard, not soft, fragile, and ready to break down, and if the probes do not pass towards the calcaneo-astragaloid joint, the surgeon may be content with thoroughly gouging out the sinus and removing all carious bone or pulpy granulation-tissue. The softer the bone the more carefully must any gouging be carried out, for fear of setting up secondary inflammation, which will itself pass on into caries.

The cavity should then be firmly plugged with strips of gauze soaked in carbolic oil or the next best antiseptic dressing at command, the Esmarch’s bandage removed, any bleeding points secured, and the parts brought together with a few points of suture. After one or two dressings, the strips may be replaced by a drainage-tube, which should be gradually shortened. When the cavity has filled up from the bottom, and the parts are healed, the patient should go about for six or eight weeks with a crutch, or a stick and a knee-rest.

If, on the other hand, the bone around the sinus is soft and friable, if the probes enter far, especially if they run towards the calcaneo-astragaloid joints, it will be wiser to remove the whole bone at once by prolonging the above incisions—the first farther inwards through the tendo Achillis, and the second farther into the sole. *See* OS CALCIS, Excision of the.

If the disease of the bone has arisen in the calcaneo-astragaloid joint, and palliative treatment has failed, the surgeon has the choice of trying to eradicate the disease by getting at it, from above, by removal of the astragalus—an operation which will necessitate division of the anterior tendons, but which has the advantage of being readily converted into a Syme’s amputation either at once or later on; or, by attacking it from below by removal of the os calcis, and then removing the articular surface of the astragalus with a chisel, and then getting completely rid of any pulpy disease or carious bone in the neighbourhood with the gouge, &c. This method only severs the tendo Achillis, which will take on a fresh attachment in the fibrous tissue and cicatrix, and leaves better drainage than the other; but it has this disadvantage, that it will hamper the operator if he finds it better to convert his excision into a Syme’s amputation.

CARIES OF THE ASTRAGALUS AND ANKLE-JOINT may be spoken of under one heading.

Diagnosis.—In both these affections the swelling is situated more anteriorly than in the preceding; the bulbous look and clubbing of the foot are more marked; if sinuses are present, probes will often pass right across the front of the foot beneath the soft parts, or, by aid of an anæsthetic, into cavities in the astragalus or across exposed bone on the non-articular part of the bone, when it alone is involved, or into the ankle-joint itself.

The ankle-joint may be found to be involved when the parts are examined with an anæsthetic, but, even if ulceration of cartilage be present, grating will not necessarily be obtained, as the intervention of pulpy tissue will often prevent the articular surfaces being brought into contact.

While the above points, together with the duration of the case, the number and direction of the sinuses, and the amount of crippling will aid in determining between the two diseases, it is often quite impossible to tell, till the parts are explored by operation, whether disease of the astragalus has involved the ankle-joint or not.

Treatment.—If palliative treatment has failed, or if the time for this has gone by, the question of excision of the diseased bone or of amputation of the foot must be faced. In deciding for or against the more conservative operation, the surgeon will be influenced by the considerations already spoken of with regard to the os calcis.

If it be decided to perform excision, the writer is convinced that in most cases of adults, and in all of children, this operation is best performed by a transverse incision, as no other sufficiently exposes the bones concerned and the limits of the disease, and as this readily admits of a Syme's amputation being performed now or later on. An anæsthetic being given and Esmarch's bandage applied, the soft parts are divided by an incision across the joint and going down to the tendons. These may be readily united, when the operation is completed, by passing silk through three or four of them above and below the points where they will be divided. The tendons are then severed, the sutures held out of the way, and the joint opened. The articular surfaces of the tibia and malleoli and the trochlear surface of the astragalus having been sawn off, any extension of the disease to the inferior tibio-fibular, the astragalo-calcanean, or astragalo-scaphoid joints should be examined into, and any suspicious patches of bone or altered synovial

membrane removed with gouge, chisel, or sharp spoon. The anterior tibial and any other arteries should then be secured, the tendons stitched together, and the wound closed with a few points of suture, a drainage-tube having been passed from side to side.

The writer is strongly of opinion that in the majority of cases the above method will be found not only easier, but superior to that by lateral excisions along the lower ends of tibia and fibula. See JOINTS, Excision of.

Two points of advantage—the complete exposure of the parts and the possibility of readily converting it into Syme's amputation—have already been spoken of; as to the disadvantage of severing the tendons, it is to be remembered that, if reunion does not take place, the free examination of the disease secured is a great set-off, and that free mobility is not a point of such primary importance in the foot as a firm, sound basis of support.

Excision of the astragalus may be performed in the same way. The bone being exposed by freely opening the joint, the ligamentous structures are then divided by a careful use of the knife, especially at the posterior part, and the bone turned out by aid of the lion-forceps and elevator. The articular and synovial structures in the vicinity should then be carefully examined, and treated, if necessary, as directed above.

Where the articular bed, out of which the bone has been lifted, shows patches of caries, or pulpy, pink, grey masses, while the astragalus is soft and fatty, easily crushing down in the lion-forceps, the recovery will not be permanent. Owing to the facility with which disease of the astragalus extends into the ankle, to the scaphoid, and the large mediotarsal synovial sac, excision of the astragalus alone will not often be called for. But, if the writer's experience be correct, there is a small class of cases, met with in children, where there is necrosis of the astragalus, a sequestrum in it, or limited caries of the non-articular part of its dorsal surface. In these cases, especially where the mischief is recent and traumatic, the prognosis is much better after removal of the bone.

DISEASE OF SCAPHOID AND MEDIOTARSAL JOINT.—Disease of the scaphoid by itself is not very common; far more frequently by contiguity of synovial membrane other bones are involved, especially the cuneiform and astragalus, by means of the large and complicated synovial membrane which is common to these and other bones.

Diagnosis.—In such a case, the most marked part of the characteristic bulbous swelling will be found more anteriorly in the foot than when the astragalus and ankle-joint are affected. This is also the case with the sinuses, and, by aid of an anæsthetic, steel probes will probably pass into the mediotarsal bones and joints, movements of the ankle-joint will be free, and grating may be obtained by lateral twisting of the centre of the foot.

Treatment.—Of all the sites of caries of the tarsus, this, on account of the number of bones which may become involved, and the difficulty of complete eradication, is one of the most important. If the disease is clearly extending, operative steps are called for early, and the surgeon has to choose between (*a*) attempting to remove all the diseased bone, (*β*) Chopart's amputation, and (*γ*) amputation at the ankle by the method of Syme or Pirogoff.

If the general and local conditions seem favourable to attempting to get all the disease away, one of the two following methods may be attempted. Free exposure of the parts by means of a flap adapted to the case, but made, if possible, mainly from the outer side, any tendons that admit of it being drawn aside, but others, where needful, being severed. The diseased bones and pulpy material being next thoroughly removed, sinuses freely laid open or scraped with a sharp spoon, and the synovial membranes along the tendinous sheaths on the dorsum examined if there be any suspicions of disease, the parts are brought together by a few points of suture, drainage being provided for.

The other method of trying to secure removal of all the disease, by going through sound parts in a case of extensive mediotarsal caries, is that practised by Dr. P. H. Watson of Edinburgh. Thus, when the disease is situated between the bases of the metatarsal bones in front and the astragalus and os calcis behind, lateral incisions three to four inches long are made from the centre of the os calcis to the middle of the fifth metatarsal bone, and from the neck of the astragalus to the middle of the first metatarsal bone, and the soft parts are then carefully dissected from the plantar and dorsal aspects of the foot through these incisions, the left thumb being kept between the point of the knife and the bones. The astragalo-scaphoid and calcaneo-cuboid joints are then opened up with a curved probe-pointed bistoury, and a keyhole saw passed between the plantar soft parts and the shafts of the metatarsal bones, and these

are cut through from below upwards. The bones being removed, the wound is firmly plugged and pressure applied with pads and bandages before the Esmarch's bandage is removed. The first dressing is kept on for forty-eight hours, its object being to prevent hæmorrhage. That this operation is an excellent one in Dr. Watson's hands is shown by five out of his six cases doing well. The objections seem to be that it is done somewhat in the dark, and that, from the amount of bone which has to be removed by limited incisions, a good deal of damage may be done to soft parts unless great care is taken. But at the present time, with the advantage of antiseptic treatment, and the thorough plugging of such a wound which this allows, it will be well worth while to make use of the above method in favourable cases or where amputation is refused. The foot will of course be kept well raised, and morphia given freely if required after the operation.

(*β*) *Chopart's Amputation.*—Where the surgeon finds it unadvisable to attempt excision, when the astragalus and os calcis are really sound, he may, if urged to leave as much of the foot as possible, make use of the above amputation. But it should always be explained to the patient, especially when the disease has been of a carious nature, that he may pay a heavy penalty for the preservation of part of his foot in the shape of recurrence of the disease in two or more years' time. If the amputation be performed, the chief anterior tendons should always be stitched firmly into the plantar flap to counterbalance the tendo Achillis, otherwise tilting of the heel, fretting of the scar, and protrusion of the astragalus, the banes of this operation, are very likely to follow.

(*γ*) *Syme's and Pirogoff's Amputations.*—While the latter, when successful, leaves no doubt a firmer, longer stump, while it is accompanied by much less wasting of the calf-muscles, so that the power of quick flexion of the knee, as in rapid walking, &c., is much better performed, on the other hand, the result of a Syme, though inferior in the above points, is still so excellent and useful that it seems scarcely worth while to run the risks of recurrence of the disease and non-union of the cut bones, risks which are undoubtedly present where Pirogoff's amputation is performed in cases of disease. Where the bones, though externally healthy, are found soft and fatty on section, or where the patient is much pulled down with suffering or advanced in years,

Syme's amputation is certainly to be preferred.

CARIES OF THE CUBOID.—Not very common, probably owing to the earlier ossification of outer side of foot. When present, may be associated with disease of fourth and fifth metatarsal bones. Excision should be resorted to with hope of good results.

CARIES OF THE METATARSAL BONES. This is not at all uncommon in children; in adults it is also met with chiefly as caries of the first metatarsal bone, when attacking one bone only, or of the middle metatarsal bones when occurring in combination with disease of the mediotarsal joints. Any of these bones, if alone diseased, may be readily and successfully extirpated by a longitudinal incision over their dorsal surface, with small incisions at right angles to this at either extremity, if need be. The soft parts are to be carefully separated either by the point of the knife, kept close to the bone, or by a blunt director; the head of the bone is to be detached first and well raised, and the base then turned out, especial care being taken at this point to avoid the plantar arch. The cartilages of the cuneiforms or the phalanges should be carefully examined, one or two points of sutures applied, and drainage provided for, if need be, by puncturing the sole on the point of dressing-forceps and passing through a drainage-tube or 'drain.' The sesamoid bones of the great toe should always be left if possible. It will be found that the toes sink considerably towards the tarsus, but the foot is, subsequently, a very useful one. The writer considers the above method of removal by a single incision much superior to that (recommended for the great toe) by a single flap from the inner side or by oval flaps, as it entails less interference with soft parts, and as the resulting scar is more entirely out of pressure. The treatment of that form of caries and necrosis of the metatarsal bones which is met with in **PERFORATING ULCER** has been described elsewhere. Caries of the metatarso-phalangeal joint of the great toe has been treated of under **BUNION**.

W. H. A. JACOBSON.

TARSAL CARTILAGES, Affections of the. See **EYELIDS, Diseases of the.**

TARSAL JOINTS, Diseases of the.—Acute inflammation of the tarsal joints is usually the result of injury, or is of pyæmic origin. The symptoms are pain, heat, and swelling over the affected joints. The pain is acute, and much increased by movement or the attempt to bear any weight on the

foot. The swelling is most manifest on the dorsum of the foot.

For *treatment* the leg must be placed upon a splint with a foot-piece, and leeches or cold applied. In the acute inflammation following a sprain, much relief is obtained by the early application of leeches. In the pyæmic or other forms in which suppuration occurs, matter must be evacuated and long rest maintained, for ankylosis of these joints may leave a very useful foot.

Chronic disease of the tarsal joints is commonly of scrofulous origin. It may begin in a single joint, as that between the calcaneum and astragalus; or in a single bone, making its way thence into the adjacent joint; or, as is more commonly the case, in the synovial membrane common to several of the joints.

Here, the early treatment of the case need not necessitate the disuse of the limb. A moulded leather splint will keep the tarsal joints at rest, while the patient rests the bent knee on a peg-leg. The health should be carefully looked after, and counter-irritation by the cauterly or small blisters be used from time to time. If suppuration occurs, and caries of the joint surfaces is suspected, or ascertained by crepitus on movement, an examination should be made of the foot during anæsthesia. The limitation of the disease will thus be more clearly defined; and if it is found to be confined to one joint, the thickened synovial membrane should be scraped away, and ankylosis aimed at. Not infrequently the disease, having started in one of the bones, is limited to the joints connected with that bone, in which case the most satisfactory results may be obtained by an excision of the bone and the removal of the diseased synovial membrane. If, however, a large number of the bones or joints of the tarsus are affected, and the disease is progressive, amputation either of the whole or part of the foot will be indicated. See **TARSAL BONES, Caries of the.**

J. WARRINGTON HAWARD.

TAXIS, the, is the attempt to reduce a hernia by manipulation. It is performed by placing the patient in the recumbent position and then exerting a gentle, steady, and kneading pressure on the protrusion. The direction of the pressure must be in the direction of the hernia and towards the mouth of the sac; thus, in inguinal hernia the pressure should be upwards and outwards; in femoral hernia downwards, backwards, and then upwards and inwards; and in umbilical hernia directly backwards.

Taxis, if performed gently, is usually unattended with danger, but much knowledge and care are needed to ascertain the condition of the contents of the sac.

In the non-strangulated condition of hernia, taxis may be used for a quarter of an hour, but the patient must be carefully watched during the attempt at reduction; if the protrusion be intestine, taxis rarely accomplishes much after ten minutes; but in simple epiplocele the taxis may be kept up for a much longer time, if a sensible impression is made on its size.

In enterocele, the taxis should consist of uniform steady pressure, so as to empty the intestine of its gaseous and fluid contents, after which the gut is easily reduced; if the protrusion is an epiplocele, the taxis must be that of a kneading character, when the omentum is gradually replaced. In the latter case much pain is often referred to the epigastric region during the taxis, which may even be succeeded by faintness and vomiting.

While attempts at reduction are being made, the sac should be kept well pushed down by the fingers of the left hand, so that it is steadied and made as tense as possible while the hernia is being reduced by the other hand. This plan enables the hernia to be more easily reduced, while the liability to *réduction en bloc* is correspondingly lessened. When the hernia is large, it must be grasped by both hands.

The success of the taxis will be materially influenced by placing the parts in such a position as will render tense the fibrous margins of the rings. The position of the thigh recommended by most surgeons, prior to the attempt at reduction, is that of semi-flexion, adduction, and rotation inwards, the effect being to slacken the margins of the rings. The writer believes that in inguinal hernia the best position for reduction is that of simple extension of the thigh, and in femoral hernia that of abduction and rotation outwards of the thigh, thus rendering the apertures tense, so that they are not pushed in front of the protrusion when taxis is employed.

Occasionally, though very rarely, ill-effects have followed the taxis, it having been succeeded by peritonitis, and even by hæmorrhage from the bowels.

It is impossible to lay down definite rules as to the length of time taxis may be, with safety, employed in strangulated hernia. This must largely depend upon the experience of the surgeon, the condition and the previous treatment of the patient, the nature and the probable condition of the

contents of the sac, and the anatomical relations of the hernia. If seen for the first time, the taxis should not be used for longer than ten minutes, and even then only gently, for more harm is likely to accrue from violent attempts at reduction than from herniotomy. Reduction may sometimes be facilitated by passing the tip of the finger into the inguinal, crural, or umbilical rings, so as to stretch them. A hot bath is frequently a valuable adjunct to the taxis in cases of strangulated inguinal hernia, but it seems to be of little use in those of the femoral variety. The administration of an anæsthetic is often of great use in the taxis.

Attempts at taxis should not be employed in cases in which there is evidence of sphacelus of the intestine, in those where there is much collapse of the patient, in those in which there is much abdominal pain, or in those in which the skin presents a dusky brown and œdematous appearance, indicative as this frequently is of gangrene of the intestine or the sac. Length of time of strangulation must influence efforts at reduction, and it is well not to attempt the taxis when an inguinal hernia has been strangulated more than four days, and a femoral more than three days. Apart from the danger of returning injured intestine, there is the great risk of returning highly septic fluid from the sac into the general peritoneal cavity. *See* HERNIA, Strangulated.
JOHN LANGTON.

TAYLOR'S SPLINT for the hip is composed of a metal bar long enough to reach along the outer side of the limb from the pelvis to the sole of the foot; it is provided with hinge-joints opposite the hip and knee, and the lower end of it is formed of two pieces, one of which slides within the other and is capable of being fixed at the requisite length by means of a ratchet. At the upper end of the bar there is a stout and well-padded metal pelvic girdle, which carries buckles to support a perineal band. There is another padded metal band attached to the middle of the thigh-piece, and a third band of soft leather fixed on to the leg-piece just below the joint for the knee. At the lower end of the splint there is a transverse bar, which may either be fixed to the sole of the boot or to a foot-piece. By turning a key, the splint may be lengthened or shortened as required. To apply the splint, the pelvic girdle and perineal band should be adjusted, and the foot should be fixed either to the foot-piece or into the boot, and then, by a turn of the key, the splint may be lengthened until the limb is

securely fixed. Finally, the bands for the thigh and leg should be buckled in position.

BILTON POLLARD.

TEALE'S AMPUTATION. See AMPUTATIONS.

TEETH AS A TEST OF AGE.—**TEMPORARY TEETH.**—The lower central incisors are erupted at the age of from six to nine months, the four upper incisors at ten months; the lower laterals and four first molars a few months later: then—after a rest of four or five months—the canines, and lastly the second molars; the whole being in place by the completion of the second year. But these dates are subject to variations, even in perfectly healthy children, and are of course much delayed by feeble health, and especially by rickets.

PERMANENT TEETH.—About the sixth or seventh year, the first molars come up, next the lower central incisors, then the upper central incisors, and a little later the laterals, this bringing us to about the eighth year. The first bicuspid appears in the ninth or tenth year, then the second bicuspid, and the canines about the eleventh year, the lower having often considerably preceded the upper. The so-called twelve-year molar is more generally a year later than its name implies, and the wisdom teeth are exceedingly uncertain, ranging from the eighteenth to the twenty-fifth year, or any later period.

When the teeth are all in place, a careful inspection of their working surfaces will reveal a varying amount of wear in young subjects, the teeth first cut having had a good many years of additional attrition; but, owing to the very various densities of teeth, too much stress must not be laid upon the absolute amount of wear, which will also be greatly influenced by the accuracy of the articulation of the upper and lower teeth.

CHARLES TOMES.

TELANGEIECTASIS. See NÆVUS.

TEMPERATURE.—Departure from the normal temperature of the body is so frequent and so important a sign of disease, that an accurate knowledge of the chief facts concerning the temperature in health is essential.

Source of Bodily Heat.—The body loses energy in two ways, in the shape of heat and in the performance of mechanical work. This energy is derived directly or indirectly from the food. Food consists for the most part of complex organic compounds, the molecules of which are held together by a

large amount of potential energy. The whole of this force is set free when the molecules are broken up into their elements, and it makes no difference whether the disintegration is effected by one or many steps, or even if the downward course is now and again interrupted by synthetical processes, in which force is rendered latent.

When food-stuffs are burnt they set free large amounts of force, which have been carefully measured and expressed as units of heat or units of work. The amount of force set free by the combustion of any food-stuff is spoken of as its *heat-value*. Now, starches and fats are completely burnt in the body and yield up to it their full heat value; but proteids are reduced only to urea, so that it is necessary in their case to subtract the heat-value of urea from that of albumen, to obtain the amount of force they give up to the body.

When the body-weight is stationary, the daily discharge of carbon, hydrogen, and nitrogen will exactly equal the quantity of these elements taken in as food. Still, the food is not directly burnt by combination with oxygen in the blood, but is probably all assimilated by the tissues to repair waste, whilst worn-out portions of the latter unite with oxygen and are removed from the system. Combustion of the tissues is, therefore, the direct source of heat: all are being consumed and all yield energy. But destructive chemical changes go on much more rapidly in some tissues than in others, and two—muscle and gland—stand out prominently; of these, muscle must, on account of its great bulk, be regarded as the chief source of heat. Of the energy set free at each muscular contraction some disappears in doing work; the rest, never less than three-fourths, and often much more, appears as heat. When not contracting, muscle, like non-working tissues, is slowly burnt.

Heat may be derived, also, from sources external to the body—e.g. fire, hot bath, hot food—which affect it by radiation or conduction; also by transformation of other forms of energy, especially motion. Thus, much of the force with which the blood leaves the heart appears as heat.

Without some means of distributing the heat developed so excessively in muscle and gland, these tissues, or parts contiguous to them, would be very hot, whilst parts consisting of skin, tendon, and bone would be very cold. The circulation of the blood is the means by which the temperature of the different parts is rendered tolerably

uniform; it cannot be strictly compared to a hot-water heating apparatus, for the blood is not warmed at one furnace, but receives more or less heat from every tissue through which it passes. In some parts—e.g. the limbs, and superficial parts generally—it loses more heat than it gains; whilst in the central portion of the trunk it gains more than it loses, the blood in the hepatic vein being the hottest in the body. The more rapid the circulation in a part, the less the heat lost by a given quantity of blood in its passage through it; consequently, the temperature of a superficial part becomes more and more equal to that of the viscera as the rate of blood-flow through it rises, but sinks rapidly under opposite conditions.

Under such circumstances the temperature of the body cannot be the same everywhere; the more peripheral parts must be colder than the more central. Consistently with health the surface temperature may vary greatly; but that of the internal parts remains remarkably constant, even under conditions of great external heat and cold. This maintenance of the exact balance between the production and loss of heat indicates the existence of a very sensitive regulating apparatus, which may act either upon the loss or production.

Heat is lost by radiation and conduction from the surface of the skin, by evaporation from the skin and pulmonary mucous membrane, by warming air and other ingesta. It is easy to see how loss of heat, through these channels, may be increased or diminished as depression or elevation of the body temperature may require. With regard to the lungs, the larger the quantity of cool, dry air inhaled, the greater the loss of heat. We cannot make much use of this therapeutically, but in fever and during exercise respiration is naturally quickened. Much more heat is lost from the *skin*, and this loss is greater the more rapid the blood-flow through the skin. Dilatation of the skin-vessels, such as occurs during strong exercise, therefore tends to keep down the temperature. As a rule, dilatation of the cutaneous vessels is accompanied by increased secretion of sweat, but not always. The secretion of sweat-glands seems to depend upon stimulation of their secretory nerves, just as that of the submaxillary depends upon excitation of the chorda tympani, without which no congestion of the gland will produce secretion. So rapidly is heat lost from a freely sweating skin, that, if circumstances favour evaporation, little or no rise of temperature will be found in a person exposed to air at 100° C. (148° F.)

On the other hand, contraction of the skin-vessels diminishes loss of heat greatly; it is induced by external cold.

Next, there are many facts which show that the *production of heat* also varies, and takes its share in the regulation of temperature. Perhaps the most conclusive is the increased absorption of oxygen and discharge of carbonic acid upon simple exposure to cold, proving that increased combustion of tissue is going on; as occurs also in fever. From these and other facts it is believed that there is a centre above the medulla oblongata, possibly in the pons, which regulates the temperature of the body, being in close connection with the vasomotor centre and having control over the metabolism of some, if not of all, the tissues.

An absolute *normal temperature* of man cannot be spoken of, for the temperature varies in different parts of the body; and even in central parts, where it is most constant, undergoes certain daily variations. Nor are the limits of these variations the same in all healthy individuals. A temperature which would be normal in one part at a certain time of day, would be abnormal in another part at the same time; and the normal temperature of a part in one person, might be abnormal for another person. The term 'normal temperature' is somewhat loosely used to express a temperature falling within the limits experience has fixed as the extremes, beyond which the temperature does not pass in health.

Diurnal Variations.—The rectal temperature in most healthy adults reaches a minimum of about 97°·5 F. (36°·5 C.) between 5 and 6 A.M. It rises somewhat rapidly up to 10 or 11 A.M., and then more slowly to 5 or 6 P.M., when it reaches a maximum of 99°·5 F. (37°·5 C.) After 8 P.M. it slowly falls. The total range is generally less than 2° F., in many people considerably less. The maximum and minimum are not attained at the same time in all people. Ordinarily, the temperature pursues the same course, whether the individual is sleeping or waking; but it is said that prolonged working at night and sleeping in the day will transpose the times of occurrence of the maximum and minimum.

Sex has no influence upon temperature; normal menstruation has no effect.

Age.—The new-born child is slightly warmer than the uterus of the mother, and for some days the average temperature is high. The diurnal variation in a baby is greater (3° F.) and less regular than in an adult. Up to puberty there is a slow loss of 0·4° F. on the average daily temperature;

and as much again is lost up to fifty. After sixty the average rises, and at eighty equals that of a baby. This rise is certainly not due to more active nutritive exchange, but perhaps is accounted for by the anæmic dry skin of old age.

Food.—It is said that during the solution of solid food a slight fall of rectal temperature occurs; all agree that during absorption there is a slight rise. Taken during the natural daily rise, food may temporarily increase it 0.5° F.; but it will not do more than delay the natural fall. Simple hot drinks cause a passing elevation, but, by increasing the cutaneous circulation, they render the loss of heat greater. Alcohol lowers the temperature, perhaps in a similar way. Strong coffee causes a rise of 0.4 to 0.7° F., reaching a maximum in an hour; tea has a weaker effect.

Exercise.—*Muscular action* raises the temperature; this is seen in infants after crying, between the pains of labour, in tetanus, and severe exercise. Rest lowers the surface temperature, a difference being noted even between lying and standing.

The Thermometer.—A mercurial instrument, maximum registering, to do away with the difficulty of reading *in situ*, is used. Besides being accurate, a clinical thermometer should be sensitive and quick-acting. *Sensitiveness* varies with the length of the degree; the larger the bulb and the finer the bore of the tube, the longer the degree. The bulb cannot be very large, as size would interfere with its introduction; the largest size and fullest contact with surrounding parts are obtained by making it cylindrical. *Quickness of action* is given by a small bulb of thin glass, and of such shape that the mercury exposes a wide surface to the tissues. Quickness of action may be increased by warming the bulb before insertion *almost* to the temperature of the patient. Sensitiveness and quickness of action therefore require somewhat different makes of thermometer; the mean must be struck, and strength for practical purposes must not be left out of account. Thermometers are best made without any external constriction between the bulb and stem. For clinical purposes, a degree clearly divided into tenths or even into fifths is sufficient; and only that portion of the scale lying between 95° and 110° is ordinarily required.

In taking a temperature it is necessary:

1. To be sure that no local influence—e.g. unusual exposure, passage of cold air, or of hot or cold fluids over it—has affected the temperature of the part selected.

2. To secure the most complete contact of the bulb with surrounding parts; for perfect accuracy the column of mercury should not be exposed.

3. To allow ample time for the mercury throughout to obtain the temperature of the cavity.

4. To read the thermometer with the axis of the eye vertically over the point of the index.

5. If the result is unexpected, to repeat the observation with extra caution and with a well-known instrument.

Temperatures are usually taken in the axilla or mouth; less often in the rectum (always in children) or vagina. Of these, the rectum is certainly the best; for it represents much more nearly than mouth or axilla the temperature of internal organs, and is much less exposed to disturbing local influences. Even its temperature is some tenths cooler near the anus than two to three inches up; the thermometer should therefore be passed well up the bowel. Ordinarily the axilla is $.5^{\circ}$ to 1° cooler than the rectum; but in old people in health the difference may be as much as 3° (Charcot). Further, the temperature of the axilla continues to rise slowly for at least twenty minutes after it is converted into a closed cavity, by laying the arm across the chest.

The temperature of a limb can generally be taken by placing a thermometer in the fold of the flexed elbow or knee, and thus surrounding it. But it is difficult to obtain measurements of the temperatures of flat surfaces, as the scalp. Surface thermometers are generally made with long bulbs coiled at right angles to the stems, so that one side lies in close contact with the surface, the other being closely surrounded by wood, vulcanite, enclosed air, or some good non-conductor. Two thermometers should be used, a comparative observation on the opposite side being made. Half an hour's contact is generally necessary.

STANLEY BOYD.

TEMPORAL ARTERY, The, is one of the terminal branches of the external carotid; it commences opposite the neck of the condyle of the lower jaw, it ascends over the zygoma immediately in front of and above the tragus, and finally ends, on a level with the highest point of the ear, by dividing into anterior and posterior superficial temporals.

LIGATION.—The trunk of the artery is reached by an incision commencing over the zygoma just above and in front of the tragus, and carried vertically upwards for

the distance of one inch. Cut through the cutaneous structures, but raise the deeper tissues upon a director. Pass the needle from behind in order to avoid the vein and the auriculo-temporal nerve, which accompany the artery. The *anterior* temporal pursues a wavy course along the limit of the hair in front of the temple; the *posterior* temporal continues the vertical direction of the main trunk towards the top of the head. Either vessel may be secured at, or immediately below, a bleeding point by ordinary ligature or by acupressure.

JAMES CANTLIE.

TEMPORO-MAXILLARY ARTICULATION, Diseases of the.—Inflammation may lead to complete ankylosis of the joint, and consequent immobility of the jaws. Arthritis occurs as the result of injury or of constitutional affection.

In children it follows the exanthemata, and is often connected with suppuration in the tympanum.

In adults it is of a rheumatic or gouty, and therefore more chronic character. Rheumatoid arthritis also affects the temporo-maxillary articulation, and leads to great suffering, from the painful movement of the jaw. In two patients the writer has noticed the characteristic enlargement of the condyle and neck of the bone, with protrusion of the chin to the opposite side, described by Robert Adams in his great work on the subject. This disease does not, however, lead to the osseous ankylosis or synostosis, which is met with in cases of common arthritis with suppuration.

Treatment.—In acute inflammation of the joint, leeching and fomentations, with timely evacuation of pus, would be the appropriate treatment. In the more chronic forms, attention to the constitutional diathesis, and the frequent application of blisters over the joint, offer the best chance of relieving the patient, but the treatment is eminently unsatisfactory.

Dr. Goodwillie, of New York, has ingeniously proposed to produce extension between the surfaces of the temporo-maxillary articulation by fitting blocks upon the molar teeth, and then drawing up and fixing the chin, and gives several cases in which a cure was thus brought about.

The ankylosis resulting from articular inflammation may be fibrous or osseous, and the diagnosis can only be made when the patient is thoroughly narcotised.

Fibrous adhesions may be broken by forcibly opening the jaws, but very great subsequent care will be necessary to pre-

vent re-union, and it may be better to do Esmarch's operation of division of the bone in front of the angle.

In cases of ankylosis of the temporo-maxillary joint, the operation of excising the condyle of the jaw has been performed in a few instances. The first removal of the condyle was by Professor Humphry, of Cambridge, and was undertaken for chronic rheumatic arthritis, and the writer performed the same operation in a case of enormous hypertrophy of the neck and condyle of the jaw. In cases of complete synostosis of the articulation, it is more satisfactory to chisel through the neck of the condyle and remove a portion of it rather than to interfere with the articulation itself. This operation gives very good results, and the slight damage to the facial nerve resulting from the necessary incision parallel to the zygoma is unimportant.

CHRISTOPHER HEATH.

TENACULUM is a sharp-pointed hook which is fixed on a handle; it was formerly used for taking up arteries on the surface of wounds, but for this purpose it is now superseded by Liston's bulldog-forceps. It is a very useful instrument for drawing the trachea upwards, and for steadying it whilst its rings are being divided and whilst the tracheotomy tube is being inserted.

BILTON POLLARD.

TENDONS, Affections of.—**WOUNDS OF TENDONS** may be subcutaneous or open. The former are usually inflicted surgically, and are treated of under **TENOTOMY**. It will be sufficient to say here of these wounds that they heal readily, give rise to no constitutional disturbance, and require very little treatment beyond what is necessary for the correction of the deformity on account of which the operation was performed. Open wounds implicating tendons will require to be treated on the general principles applicable to such injuries. See **WOUNDS, Treatment of**. As regards the tendon, the treatment is simple. The severed ends must be united. This may be effected by stitching with carbolised catgut, chromic gut, or silver sutures. The two latter are better, because they do not loose their hold so readily as the common catgut. In an aseptic wound chromic gut is best, but in a suppurating wound silver would be necessary. In this last instance, however, it is very doubtful whether union would be effected, sloughing of a portion or whole of the tendon being more probable than union. In sewing the ends of tendons a curved

needle is best, and the continuous suture (unless silver is used). It is always advisable to make the parts aseptic, if possible, and prevent suppuration. For if the latter event occurs, there is apt to be spreading of the inflammation along the tendon sheath or sheaths, and sloughing of the tendons themselves. In the after-treatment such a position of the parts should be adopted as would relieve all strain on the tendon.

RUPTURE OF TENDONS occurs only in adults, is caused by sudden muscular contraction, and is most common in the lower extremity. The tendo-Achillis is most frequently torn, next the ligamentum patellæ, which is in reality part of the tendon of the quadriceps extensor cruris; in the upper extremity, the tendons of the biceps and triceps. The accident occurring in the lower extremity is usually from the person slipping, and making a sudden effort to prevent himself falling. The patient feels as if the part had been struck; there is a sharp pain for a moment; he falls to the ground and is unable to move the limb, and in some cases a crack has been heard. On examining the injured part, a distinct depression is felt at the point of rupture. The muscle is drawn up, and, in the case of the ligamentum patellæ, the patella is drawn up also, thus making the diagnosis easy as between fracture and rupture. Treatment is directed towards approximation of the torn ends of the tendon. This may be done by position. In the case of rupture of the tendo-Achillis, the leg should be flexed on the thigh and the foot extended. The patient may lie in bed or be permitted to go about with crutches, and the leg kept up by means of a cord passed through the heel of a slipper and secured to a belt round the thigh. When the ligamentum patellæ is ruptured, the limb should be kept straight and elevated, and the patella should be drawn down by strips of plaster, or by bandaging, as in fracture. See **PATELLA**, Fracture of the. A more thorough method of treatment is to suture the ends together. See *Wounds of Tendons*. This should always be done with strict antiseptic precautions. Such an operation cannot be performed when the tendon is torn from its insertion.

UNION OF TENDONS.—Union takes place more quickly in cut than in torn tendons. Also much more quickly and accurately when they are stitched than when they are not. In children union has been observed in two or three days, and in adults use of the part has been possible after a fortnight, or even ten days. It is doubtful whether

tendons contained in sheaths unite as readily as those which are not; but there is no doubt that the latter are more prone to slough after injury. Every care should be taken in their case, therefore, to promote union and avoid inflammation.

The new material which unites the ends of severed tendons is, at first, connective tissue with a large amount of cellular elements. Gradually the cells diminish and the fibres increase, the structure at the same time becoming stronger and harder, and like the original tissue. While this process is going on months may elapse, the time varying according to the amount of new material that has to be formed. At first this, when soft, is capable of being drawn out, and advantage of this fact is taken where tendons are cut (*see TENOTOMY*) for deformities, most surgeons allowing the divided ends to unite first and then extending them gradually by apparatus. It must always be remembered that the new fibrous material has also the property of contracting, and retains this for a long time.

DISLOCATION OR DISPLACEMENT OF TENDONS.—Those most frequently supposed to be displaced are the long head of the biceps at the shoulder; the tendon of the extensor carpi ulnaris at the wrist, in cases of fracture of the lower end of the radius; and the tendon of the peroneus brevis at the outer ankle.

Causes.—Most of the cases recorded have been associated with arthritic disease, or connected with some injury, such as fracture. Dislocation of the tendon alone may, however, occur from injury, and in such a case diagnosis should be easy. The tendon will be felt in an abnormal situation, while a hollow will be left where it came from. The muscle which acts through it will be inefficient, and the joint acted on will be stiff or useless. The tendon will probably be easily replaced after it is relaxed, but will not be likely to remain in its position on account of the sheath being torn.

Treatment will consist in replacing and retaining the tendon in position, if possible, by strips of plaster, bandaging, or other means. Inflammation will be prevented by cold applications, and after a few days *passive* movements should be employed to prevent adhesion of the tendon. Should reduction or retention be impossible, the patient may be comforted with the assurance that the parts will ultimately become almost as useful as ever.

Dislocated tendons are favourite injuries with 'bone-setters.' What they generally treat as such (and not infrequently successfully) are adhesions of ten-

dons to their sheaths after injury or rheumatism. *See* BONE-SETTING.

INFLAMMATION OF THE SHEATHS OF TENDONS.—Tendons themselves do not often inflame, but their sheaths do. This affection is always a serious matter. It may be divided into three varieties:—1. *Simple Acute Thecitis*, or *Tenosynovitis*; 2. *Simple Chronic Thecitis*; and, 3. *Suppurative Thecitis*, of which last whitlow is a common example.

ACUTE THECITIS.—*Causes.* Injury, strain, wound, amputation, rheumatism, extension of inflammation from a neighbouring joint.

Symptoms.—Pain along the tendon or tendons, aggravated by movement or pressure, swelling extending at first in the line of the tendons, a peculiar sensation, resembling crepitation, imparted to the fingers when passed over the part, due to the presence of fluid in the sheath; lastly there may be fluctuation.

Results.—There may be recovery under proper treatment, supervention of chronic conditions, adhesion of the tendon to its sheath from effusion and organisation of lymph, suppuration, which is liable to extend, and lastly sloughing of the tendon or tendons.

Treatment.—Rest, fomentations, leeches, blisters, incision to relieve tension. When suppuration has taken place, immediate and free incision is always necessary if the tendon is to be saved. Even when the effusion is only serous or sero-purulent, *aseptic* incision may be advisable. Thorough drainage should be provided.

CHRONIC THECITIS.—*Causes.*—Previous inflammation, injury (more especially a sprain), and the rheumatic condition.

Symptoms.—Pain and stiffness, weakness of the part (always a prominent symptom), tenderness and swelling, crepitation, or creaking from effusion. Loose bodies like melon-seeds may be in the fluid contained in the sheaths. There is not infrequently rheumatic arthritis of a neighbouring joint.

Treatment should be constitutional if there is rheumatism or arthritis present; locally rest (if possible), counter-irritation, pressure by strapping or elastic bandaging, tapping if there is much effusion, or free *aseptic* incision if there are lymph-bodies. Permanent weakness of the part from want of use, contractions or adhesions of the tendons to their sheaths, are very apt to follow.

Diagnosis.—Sometimes some difficulty may arise in cases of acute or chronic thecitis in differentiating them from sprains

or even fractures, and from disease of a joint. As regards the first, the two affections are often combined; in fact, inflammation along the line of one or more tendons is an almost necessary concomitant of a sprain of a joint. Where thecitis exists alone, the limitation of the pain and swelling at first to the line of the tendons, and the absence of ecchymosis afterwards, should be sufficient guides. The situation in which inflammation of tendon-sheaths is liable to be mistaken for fracture is above the outer ankle, where the peronei tendons cross the fibula, in which situation the presence of crepitation and pain on pressure are apt to make the hasty observer suppose that what he feels is the crepitus of a Pott's fracture obscured by swelling. The diagnosis should be made out by the absence of deformity and unnatural mobility at the painful part, by the ascertained integrity of the fibula, and by the mode of injury, which would not be eversion of the foot. Diagnosis from disease of a joint would be made by attention to the exact situation of the pain, swelling, &c.

SUPPURATIVE THECITIS.—This is most commonly met with in three forms. First, in connection with amputations and excisions, where there is suppuration which extends to and along the tendon sheaths; secondly, in cases of compound fractures or dislocations with suppuration; and, thirdly, in cases where the suppuration commences in the sheath, as in whitlow of the finger. The symptoms are those of suppuration generally; feverishness, often preceded by a rigor; swelling; heat; redness, which in the case of a whitlow disappears whenever tension is marked. Pain is always great.

Treatment consists in free incision. *See* WHITLOW.

TUMOURS OF TENDONS.—Fibromata, Enchondromata, Osteomata, Cysts (in the form of ganglia), and Gummata. Tendons are not liable to be affected by new-formations, but, on the contrary, resist their invasion longer than most textures. *See* TUMOURS; GANGLION; BURSE, Affections of. A. G. MILLER.

TENO-SYNOVITIS. *See* TENDONS, Affections of.

TENOTOMY signifies the subcutaneous division of tendon or fascia.

A narrow-bladed knife is introduced a short distance from the tendon to be operated on, and, guided by the finger, made to divide it. On its withdrawal, a piece of folded lint, with a strip of soap-plaster

across to fix it, is placed on the puncture, and the foot is bandaged to a splint, and kept at rest for four or five days until the puncture is healed. The result is the same as if no wound of the skin at all had been made, and as if no communication had ever existed between the severed tendon and the external air.

It has been shown on dissection, and proved by experience, that the ends of a divided tendon become perfectly united by an intervening substance, which, after a time, becomes indistinguishable from the rest of the tendon, and that the lengthening of the tendon by this means can be regulated by the extent to which the new tissue is gradually stretched during the first few weeks after tenotomy.

In the performance of tenotomy, care must be taken to keep the knife *close* to the tendon to be divided, so that no artery or nerve may be injured. But, as in almost all cases requiring this operation, the tendon or fascia is unnaturally prominent, owing to its contracted condition, there is not the same difficulty in finding it that there would be in the normal state, nor is there the same danger of wounding adjacent structures.

The chief tendons and fasciæ that may require division are:—The tendo Achillis, the tibialis posticus, the tibialis anticus, the peroneus longus and brevis, the plantar and the palmar fascia, the extensor longus digitorum with the peroneus tertius, the biceps femoris, the semitendinosus and the semimembranosus, the sterno-mastoid. There are some others that may require division, but these require no separate description. The method in which the tendons mentioned above are operated upon is as follows:—

THE TENDO ACHILLIS.—The operator sits at the end of a table, with the assistant on his left. The patient lies on his face on the table, with his foot slightly overhanging the end. The assistant then grasps the calf of the leg with his left hand, and the anterior part of the foot with his right, and flexes it slightly, thus bringing the tendon prominently forward. The operator then puts his left thumb on the tendon, and introduces a sharp-pointed tenotome flatwise beneath it, and at this moment the assistant, making further extension, he turns the knife and divides it from below upwards. When the assistant feels the tendon give way, he relaxes the extension. This is important, for, if it is not done, there is some danger of the knife slipping through the skin. In this operation the knife may be introduced

either on the inner or outer side of the tendon; but in the latter case it must be remembered that the posterior tibial artery is not far from the point of the knife, which should not be thrust in too deeply. With ordinary care there is no danger of wounding the vessel.

THE TIBIALIS POSTICUS.—The operator sits at the foot of a table, with the assistant on his left. The patient lies on the same side as the deformed foot, and, the other foot being held out of the way, the assistant grasps the leg firmly just below the knee with his left hand, and with his right holds the foot well flexed in the deformed position. The operator then feels for the inner edge of the tibia, and just over this, and about an inch (two inches in an adult) above the tip of the internal malleolus, makes a puncture with a sharp-pointed tenotome, and passing it down to the edge of the tibia, and, guided by this, opens the sheath of the posterior tibial tendon. The sharp-pointed knife is then withdrawn, the assistant being careful to keep the foot in exactly the same position. The operator, now holding a blunt-pointed tenotome like a pen, introduces it into the opening, and insinuates the blade flatwise between the tendon and the bone. Having indicated to the assistant to evert the foot, he turns the edge of the knife towards the tendon, and, supinating his wrist, divides it and also the adjacent tendon of the flexor longus digitorum. A snap is felt at the moment of the division of the tendons.

THE TIBIALIS ANTICUS.—The patient lies on his back, and the operator and his assistant place themselves as before. The operator works the foot from side to side, and feels with his forefinger for the tendon of the tibialis anticus. Keeping his finger over the tendon, he introduces a sharp-pointed tenotome with its edge towards it, between it and the tendon of the extensor proprius pollicis, and, the assistant making at this moment forcible extension, he divides it.

THE PERONEUS LONGUS AND BREVIS.—The patient lies on the opposite side to the deformed foot, and a cushion is placed under the lower part of the leg, with the foot extending over it. The operator sits at the foot of the table, with the assistant on his left. The assistant grasps the leg with his left hand, and with his right holds the foot up, so as to slacken the tendons as much as possible. The operator, placing his left forefinger on the tendons, introduces a strong, sharp-pointed tenotome flatwise, in an oblique direction, between

the fibula and the tendons two inches (in an adult) above the end of the malleolus, and having turned the edge towards the tendons, the assistant making extension, divides them.

THE EXTENSOR LONGUS DIGITORUM, AND THE PERONEUS TERTIUS.—The patient lies on his back. The operator sits at the foot of the table, with the assistant on his left. The assistant grasps the leg with his left hand and the foot with his right. The operator, keeping the fingers of the left hand on the tendons, introduces a sharp-pointed tenotome between the tendon of the extensor proprius pollicis and the tendons to be divided, and guiding the blade beneath these tendons, he divides them. Care must be taken not to dip the point of the knife deeper than necessary, or the anterior tibial artery may be wounded. The duty of the assistant will be rather to prevent the foot from suddenly falling than to make extension.

THE PLANTAR AND PALMAR FASCIA.—In the subcutaneous division of fascia, the object of the surgeon should be to divide every portion of it as efficiently as possible, and to retain the divided edges as much apart as possible. If it be found that one puncture is not sufficient for this purpose, two or more may be made. In the case of the plantar fascia, it is best to cut it bit by bit rather than to attempt to divide it all by one sweep of the knife, and it is a matter of indifference whether the edge of the knife be directed towards or from the skin.

The foregoing descriptions apply to a surgeon operating with his right hand on the tibialis anticus and posticus, or on the plantar fascia of the *left* foot, or on the peronei or extensors of the *right* foot. If the contracted tendons, however, are situated on the other side, and the operator cannot use his left hand, he must stand facing the foot of the table which is on his right.

BICEPS FEMORIS.—The patient lies on his face. The operator places himself on the same side of the table as the leg to be operated on. An assistant supports the leg in the flexed position. If possible, this operation should be performed without the previous administration of an anæsthetic. The patient should attempt to flex the knee-joint, the assistant holding the leg firmly at the same time. This will bring the tendon prominently forward. The operator then introduces a strong, sharp-pointed tenotome on the *inner* side of the tendon, keeping the blade close to it, and insinuates it under it. The knife then lies between

the tendon and the peroneal nerve, and, cutting outwards and upwards, the tendon is divided and the nerve is uninjured. On the knife being carefully withdrawn, the nerve will be observed to come more prominently forward than before, and care must be taken not to mistake this for part of the tendon.

THE SEMITENDINOSUS AND SEMIMEMBROSUS.—The knife should be introduced on the *outer* side of these tendons, and care must of course be taken not to dip the point deeper than necessary, owing to the position of the popliteal artery.

THE STERNO-MASTOID.—Either the sternal or the clavicular portion of the sterno-mastoid may require division. If it be necessary to operate on both portions, a separate puncture must be made for each. The patient lies on a table, and the operator stands on the same side as the muscle to be divided. A puncture is made on the *inner* margin of the muscle in its lower third. A blunt-pointed tenotome is then carefully introduced, on the flat, through the opening, and, guided round the border of the muscle, is passed behind it. The sharp edge of the knife is then turned towards the muscle, and made to divide it from within outwards. The assistant, during the operation, holds the head firmly and keeps the muscle tense.

HENRY F. BAKER.

TESTIS, Diseases of the.—**ACUTE INFLAMMATION.**—It is important to distinguish between inflammation of the epididymis and of the testicle proper or body of the organ. The former will be spoken of as epididymitis, the latter as orchitis. The two may be combined, the disease spreading from one organ to the other. Epididymitis is much more frequent than orchitis, and it is only rarely that the inflammation passes from the epididymis to the secreting part of the organ.

Causes.—The most frequent cause of *epididymitis* is inflammation or injury of the prostatic urethra or seminal vesicle, such as occurs in gonorrhœa, stricture, impaction of a calculus, the passage of a catheter or other instrument along the urethra, and lithotomy. Epididymitis is the commonest complication of gonorrhœa, occurring most often about the third week of the disease; it is due to a direct extension of the disease along the vas deferens, and not to metastasis. It is specially likely to occur in the subject of gonorrhœa after indulgence in alcohol, sexual excitement, violent exercise, or the use of strong injections or of a ca-

theter. Injury, such as a contusion against a saddle, is a frequent cause of epididymitis, and the disease is also excited by acute inflammation of the tunica vaginalis, such as is caused by stimulating injections in the radical cure of hydrocele. Acute hydrocele and epididymitis have also been met with in smallpox.

The causes of acute *orchitis* are injury, mumps, rheumatism, gout, and excessive ungratified sexual desire; very rarely it occurs in the course of typhoid or malarial fever. Orchitis is more frequent in certain epidemics of mumps than in others, and may occur without any affection of the parotid gland; it generally comes on towards the end of the first week of the disease, and is liable to be followed by atrophy of the organ. Acute inflammation of the testicle may be met with in infants and young children, as the result of injury, or, in some cases, as the result of phimosis; in other cases it appears impossible to assign a sufficient cause.

Pathology.—The inflammation is marked by hyperæmia of the vessels of the spermatic cord, of the epididymis and testicle, of the tunica vaginalis, and commonly also of the scrotum. In epididymitis, the greater part of the swelling is due to inflammatory exudation around the convoluted tube or tubes of this organ; but a similar exudation is found infiltrating the wall of the tube, and even filling up its lumen. In acute inflammation of the body of the organ, a small-celled inflammatory exudation is poured out between the seminal tubes; these are compressed by it, and, at the same time, become choked by the products of a hyperplasia of their epithelial lining. Inflammation of the tunica vaginalis very commonly accompanies acute epididymitis. This may lead to hyperæmia of the membrane and the effusion of a small quantity of fibrinous lymph on its surface, ending in adhesions between the two surfaces, or entire obliteration of the sac; or there may be an effusion of a richly fibrinous fluid into the sac—acute hydrocele—which then adds considerably to the swelling of the part. When the inflammation of the testicle is intense, the scrotal coverings are reddened by hyperæmia, and the veins especially may be engorged, and the tissues œdematous.

The disease most often terminates in complete resolution, but, in not a few cases, a small hard nodule is left behind in the globus minor of the epididymis, which on examination is found to be caused by a thickening around the duct of the testicle

and an obliteration of its lumen; the duct above this plug may be more or less dilated. This condition is of great importance, as, if it occur on both sides, it renders the subject of it sterile, and when of long standing it is incurable. Abscess is a rare termination of the disease, whether it affect the secreting part of the organ or its duct. A still rarer complication is gangrene of the scrotum, due to the intensity of the inflammation of the coverings of the testicle. When the body of the testicle is inflamed, the subsidence of the inflammatory process may be followed by atrophy of the organ. This more often occurs in connection with parotitis than in other varieties of orchitis, and is more frequent in some epidemics than in others, and it appears not to be dependent upon the intensity of the inflammation. Gonorrhœal epididymitis is more common on the left side, and rarely attacks both testicles simultaneously, although the second testicle may be attacked subsequently to the first. The affection is most frequent and generally most intense in the globus minor, and it is here also that the swelling remains longest, and is apt to leave behind a permanent thickening.

Symptoms and Diagnosis.—The onset of the affection may be very abrupt, but it is more often preceded by an aching pain along the spermatic cord of the same side, and, if an examination is made at this time, the cord is found full and the vas deferens more or less swollen. In exceptional cases, there is marked swelling of the cord for some hours previous to the swelling of the testicle. The severity of the symptoms of acute orchitis varies within somewhat wide limits; some patients are completely incapacitated by the disease, while the majority manage to attend to their usual avocations, albeit suffering more or less severely. The symptoms of the affection are swelling, pain, redness of the scrotum, together with evidences of constitutional disturbance. The swelling is always a marked feature of the disease, and has caused the name ‘swelled testicle’ to be commonly used for this complication of gonorrhœa. It varies in amount, position, and character with the parts affected.

When the epididymis alone is inflamed, the swelling is limited to the back part of the organ, where a slightly uneven, elongated, firm mass is felt, which projects above and below the unaffected body of the testicle. When the disease implicates the globus major or globus minor exclusively or principally, the swelling will be limited to or most extensive at the upper or lower

part of the organ. When the testicle is inverted, the swollen epididymis will lie along the front of the organ. The swelling due to orchitis proper is situated in front of the organ, and is more even in outline than that of epididymitis; owing to the unyielding tunica albuginea it never attains a great size. Acute hydrocele is a far more frequent cause of swelling over the front of the testicle. When the effusion is abundant, it greatly adds to the total bulk of the scrotal enlargement, and may cause a marked bulge in the front of the scrotum. This swelling is even in contour, and its fluid nature is recognised by the sense of fluctuation it affords. It obscures the testicle proper, but not the inflamed epididymis. The spermatic cord is more or less swollen and firm, the thickened vas deferens being tender to the touch. Œdema of the scrotal coverings may add to the general swelling.

The pain is usually severe. It is described as of a heavy, dragging character, extending up along the cord to the groin, and round to the loin of the same side. The position of the tenderness is of use for diagnostic purposes; when the epididymis is inflamed, the tenderness is limited to this part of the organ; when, however, the body of the testicle is also inflamed, the tenderness as well as the pain is most marked over the front of the inflamed organ. Care must be taken in making this examination, for pressure made upon a healthy part may be transmitted to an inflamed part, and cause pain; this error is, however, easily avoided. The scrotal coverings may be scarcely at all affected; generally the skin is reddened, the superficial veins are distended, and the dartos is more or less œdematous. The constitutional disturbance is manifested by fever, a quickened pulse, a furred tongue, anorexia, and constipation.

Under judicious management the pain, tenderness, and fever quickly subside, and the swelling gradually diminishes, in most cases leaving a painless induration of the globus minor of the epididymis, which slowly disappears but may be permanent. When the acute symptoms have subsided and the swelling has been entirely, or in great part, absorbed, the testicle may be left in a very irritable condition, painful, very tender to the touch and on contact with the clothes and thighs in walking; and this state, which is one of considerable importance, is apt to be chronic and difficult to alleviate. When the duct of the testicle is plugged by lymph, not only is the testicle useless for fertilising purposes, but the act of intercourse is apt

to be followed by pain and swelling of the gland. The occurrence of abscess is attended with persistent and even increasing pain and tenderness, increase of the swelling at a particular part, and fluctuation; with these local symptoms there is fever, and there may be one or more chills or rigors. Abscess most often occurs at the globus minor and points at the lower end of the scrotum. In delicate, strumous subjects, the abscess may be subacute or chronic in its course. Gangrene of the scrotum is to be feared when the swelling of its tissues reaches a high grade. Gangrene of the testicle itself can only be verified when, at the bottom of an abscess of the scrotum, the sloughed organ is seen. Atrophy of the testicle gives rise to no symptoms except a wasting of the body of the organ, the epididymis not being affected.

The *diagnosis* of acute inflammation of the testicle, as a rule, presents no difficulty; the acute onset of the disease, the swelling of the testicle itself, the severe pain and tenderness, the fulness and thickening of the cord, and the fever are eminently characteristic. By the shape and position of the swelling, and the site of greatest tenderness, epididymitis is readily distinguished from true orchitis. The signs by which acute hydrocele, abscess, and gangrene are to be recognised have also been already stated. Acute inflammation of a retained testicle may be mistaken for a strangulated hernia. For the diagnosis, *see* TESTIS, Malpositions of the.

Treatment.—In the acute stage of the disease, it is very important that the patient should be at rest in the horizontal position with the scrotum well supported, either by a pillow between the thighs, a handkerchief suspender, or a broad strip of strapping passed across from groin to groin. When the case is seen early, and the patient is young and otherwise healthy, cold is the best local application. The usual plan is to suspend a bag of cracked ice to a bed-cradle, so that it rests lightly upon the scrotum; but a still better plan is to surround the scrotum by a coil of rubber tubing through which iced water circulates; the coil being similar to that used by Otis for the penis. Should cold fail to relieve the pain, or if the patient be old or cachectic, or the inflammation have lasted more than twenty-four hours before treatment is commenced, or be associated with mumps, or if there be great œdema of the scrotum, local heat is to be employed, combined with the application of belladonna or opium. Hot belladonna or poppy-head fomentations may be

used; but a simpler and equally beneficial plan is to cover the testicle with a thick layer of equal parts of extract of belladonna and glycerine spread on linen, and over that to apply hot fomentations, which should be renewed every hour, the belladonna being re-applied once a day. The diet should be restricted to unstimulating slops, and the bowels be well opened by a saline purgative combined with tartar emetic, a good formula being, a drachm of sulphate of magnesia with $\frac{1}{4}$ grain of tartar emetic, given every four hours until a distinct effect is produced upon the bowels. In robust, plethoric young men, this may be preceded by a purgative dose of calomel (gr. v. to x.), but in the majority of cases this is not requisite. Under this treatment the acute symptoms as a rule quickly subside, and the patient is able to get up in forty-eight or seventy-two hours, but convalescence is much hastened by a continuance of rest in the horizontal position. In the orchitis of mumps, neither cold nor any form of lowering treatment is to be employed, and, owing to the frequency with which atrophy of the testicle follows this form of the disease, great care is to be exercised in the treatment of even the mildest case; a diaphoretic and diuretic saline mixture is the best internal remedy.

When the tunica vaginalis is distended with fluid and the seat of acute pain, rapid and marked relief is obtained by puncture of this sac either with a fine trocar or a narrow knife; but the puncture should not extend into the testicle itself. When abscess is diagnosed, it should be opened by means of a fine knife, and a small drain of catgut, horsehair, or rubber tubing may be introduced into the cavity. If the œdema of the scrotum is so intense as to threaten strangulation of its vessels, it should be at once relieved by several incisions about three-quarters of an inch long, and over the part boracic acid fomentations should be assiduously applied. When there is great congestion of the scrotal veins, and the patient is plethoric and the disease acute, relief will be obtained by a local venesection. The man should stand up for a few moments, and then one or more of the largest veins of the scrotum should be opened by a lancet, and from three to six ounces of blood may be abstracted. When the disease is not very acute and the patient cannot rest entirely, the best local treatment is belladonna and glycerine on linen, covered by a thick mass of cotton-wool, the whole being enveloped in oiled silk or india-rubber tissue, and supported in a handkerchief. The handkerchief

should be folded three-cornerwise, and a piece of tape is to be sewn to the middle of the longest side; this part is to be placed behind the scrotum, and the tape drawn up between the buttocks and fastened to a band round the waist; the two long ends of the handkerchief are to be drawn up along either groin and fastened in front to the same band, and the remaining corner is then to be folded up in front and pinned to the waistband. By this means the testicle is not only held up, but also kept forwards out of the way of the thighs in walking. Two or three times a day, the testicle should be well fomented with water as hot as can be borne. *See* SUSPENSORY BANDAGE.

When the period of acute pain and congestion is passed, the patient should, if possible, still rest, but when necessary may be allowed to get up, wearing a well-fitting suspender. Gentle friction with a small piece of belladonna ointment night and morning is the only local treatment required in most cases. But where the effusion has been great, or its absorption occurs slowly, this may be hastened by carefully applied circular compression of the testicle. This compression may be obtained by strapping, an elastic bandage, or a laced suspender. Where an indolent nodule is left behind in the globus minor of the epididymis, friction with unguentum hydrargyri is the best application, and should be persevered with until no thickening or induration is to be detected. All urethral medication and instrumentation are to be suspended during an attack of epididymitis. The discharge of gonorrhœa usually lessens and disappears during the acute stage of epididymitis, but reappears on its subsidence; this is not evidence of metastasis, but of the derivative effect of the testicular inflammation. In malarial orchitis, which is liable to relapse, quinine should be exhibited. In gouty orchitis, the usual treatment for this diathetic condition is indicated, alkaline salines with colchicum being exhibited, and the diet being suitably restricted. Where the condition of irritable testicle, above referred to, exists, iodide of potassium (gr. x. to xv. a day) should be given; if the patient be anæmic, iron and cod-liver oil with change of air will afford most speedy relief. This condition is often very obstinate and difficult to relieve.

CHRONIC INFLAMMATION.—Causes.—By far the most frequent cause of chronic orchitis is constitutional syphilis. The testicle becomes affected most often within two or three years of the occurrence of infection, between the subsidence of the

secondary eruptions on the skin and mucous membranes and the development of the deep tertiary diseases of bones and viscera. But syphilitic orchitis may come on at a much later period, and in patients in whom there is no other concurrent syphilitic phenomenon. It is believed that the affection is often excited in the testicle by slight blows or by venereal excesses. Occasionally, chronic orchitis develops in young infants the subjects of hereditary syphilis. Stricture of the urethra sometimes leads to chronic inflammation of the testicle, and, in some cases, exposure to cold and wet or prolonged venereal excess has seemed to be the starting-point of the disease. Gout, rheumatism, or long residence in malarious districts, may induce chronic orchitis; and very occasionally it is a sequel to acute traumatic orchitis.

Pathology.—The morbid change in the testicle consists in a chronic inflammation of the intertubular tissue of the organ, which, with rare exceptions, is limited to the secreting part of the gland, and does not spread to the epididymis. In many cases, if not in all, the inflammation first affects the tunica albuginea, and spreads in from this membrane along the fibrous dissepiments of the organ, involving lobe after lobe, but very rarely, if ever, extending as far as the rete testis and the vasa efferentia. The tunica albuginea becomes considerably thickened, and, as at first the disease is limited in area, the part has a nodular feel, but, as the affection spreads and involves more of the fibrous covering of the organ, this nodulation lessens and is lost. The inflammation may extend inwards uniformly over several lobes, or may be limited to certain lobes, and attain a higher grade in particular spots; and, in this way, variations in the appearance presented by the diseased organ are produced. The inflammatory exudation consists of small round nucleated cells and delicate fibres, which surround and separate the seminal tubules; the epithelium lining these tubules undergoes fatty degeneration and is shed. When the inflammation does not attain a high grade or continue very long, the exudation may be absorbed and the damage done to the tubules be repaired, the testicle being restored to its original structure and function; if, however, the injury done to the tubules have been too severe to permit of this, the absorption of the inflammatory exudation is attended with wasting of the organ, and, when this is total and bilateral, it induces both impotence and sterility. On the other hand, the inflammatory neoplasm

may organise into dense cicatricial fibrous tissue, in which no trace of the tubules is to be detected, or it may undergo slow degenerative changes.

When a gradual obliteration of the arterioles occurs, with dry fatty degeneration of the tissue, typical gummata are produced. In other instances, the degenerated tissue breaks down into fluid débris; this may be encapsuled in firm fibrous tissue, or, inflammation being excited around it, the testicle becomes adherent to the scrotum, and an opening is formed through which the puriform matter is discharged. From the wall of the cavity thus emptied an active growth of granulation-tissue takes place, which fungates through the sinus. See HERNIA TESTIS. Where the chronic inflammation has its chief seat in the tunica albuginea, the thick exudation on the outer surface of this membrane may undergo similar changes; the tissues of the scrotum then ulcerate and expose the testicle, from the surface of which granulations may sprout, or the part may exhibit the sloughy appearance common in cutaneous gummata. The tunica vaginalis is generally involved in the inflammation; at the early stage fluid is effused, generally in small quantity, which fluid, unlike that of simple chronic hydrocele, may coagulate spontaneously. Later on, the fluid is absorbed, and the two serous surfaces of the tunica vaginalis may be partially or wholly adherent. When hydrocele is combined with chronic enlargement of the testicle, the condition is known as *hydrosarcocoele*; the fluid is occasionally so abundant as to entirely obscure the testicle. The vessels of the cord are engorged, giving a sensation of fullness to the part; very rarely it is indurated, and it has been known to become the seat of gummatous enlargement. The tissues of the scrotum are generally unaffected; but when the inflammatory products in the testicle soften down, the skin and subcutaneous tissues become inflamed, adherent, and at length ulcerated. Syphilitic orchitis affects both testicles more often than any other disease to which these organs are subject. It is rare for both testicles to be attacked simultaneously; more commonly, the inflammation advances for some time in one before spreading to the other organ, or it is only after the subsidence of the disease in the first that the second becomes affected, and there may be a considerable interval of time between the invasion of the two testicles.

The epididymis usually escapes altogether in syphilitic orchitis; it may, how-

ever, be involved either with or separately from the body of the organ. The change is the same as in the secreting part, consisting of an interstitial inflammation between the tubes of the globus major and in the fibrous covering of the coni vasculosi.

Symptoms and Diagnosis.—The onset of the affection is often unobserved by the patient, who has his attention first called to the part by accidentally feeling a hard lump in one testicle. In some cases, however, the testicle is tender from the first. In harmony with its insidious onset is the slow and painless course of the disease. The testicle is enlarged, and sometimes attains as much as three times its original bulk, being ovoid and flattened on its sides, and generally by its increased size obscuring altogether the epididymis. In the earlier stages, the enlargement is nodular and affects only a part of the body of the testicle, but, later on, the irregularities of the surface lessen and more of the organ may become involved, until no part of it is felt to be healthy. The inflamed part is firmer than natural, and oftentimes is of extreme and even stony hardness. The special testicular sensibility is lost early, and there may be an entire absence of both pain and tenderness; but more often the part is tender to pressure at some spot, and, occasionally, patients make considerable complaints of both pain and tenderness, but these acuter symptoms are rare and generally transient, the usual course of the disease being insidious, slow, and painless.

The spermatic cord is usually fuller than normal, but is not indurated. Fluid is often present in the tunica vaginalis in greater or less quantity, increasing the swelling and obscuring the exact outline of the testicle; this can be detected by the presence of fluctuation, and also by translucency of the anterior part of the scrotal swelling. The term *hydrosarcocele* is applied to this condition. The skin of the scrotum is generally of normal appearance, but when the inflammatory products in the testicle soften, it becomes adherent to the organ, reddened and inflamed, an abscess bursts and a sinus may be left, or extensive ulceration occur, or a hernial protrusion from the testicle develop. The opposite testicle may be healthy, or may be similarly affected, the disease attacking one testicle after the other. Relapses and recurrences of the affection are also met with. A history of syphilis is to be obtained in the great majority of cases, and in many cases there are other evidences of this disease present at the time. When both organs are involved in the inflammation, sexual desire and power are alike lost, and this condition

is permanent when the testicles atrophy or the inflammatory products develop into dense cicatricial tissue. In some instances of apparent cure of the disease, the semen continues to be void of fertilising power.

Under suitable treatment, the induration and enlargement of the testicle generally disappear, testicular sensibility returns, and the part is restored to its former condition. In some cases, however, the organ wastes away, and nothing may be left but a small nodule adherent to the front of the unaffected epididymis. In other instances, when the disease has run a very chronic course, and has converted the testicle into a mass of cicatricial tissue, the organ remains of irregular outline, extremely hard and painless. Hernia of the testicle is considered elsewhere. When, with considerable enlargement of the testicle, one prominent nodule is felt, and this nodule resists the effects of treatment more than the surrounding parts, it is probably a gumma. Gumma of the testicle is not infrequently unilateral, and it is met with at a later period in the course of syphilis than simple interstitial inflammation. In many cases, it is impossible to recognise the presence of gumma except by dissection of the organ. When, in spite of careful and prolonged local and constitutional treatment, the testicle remains enlarged, hard, and the seat of occasional attacks of pain, it will generally be found, on removal of the organ, that it is the seat of a chronic abscess with a thick indurated wall of fibrous tissue surrounding the inflammatory débris.

The *diagnosis of Chronic Orchitis* is generally easy: the gradual painless enlargement of the testicle proper, with marked hardening and loss of its special sensibility, the absence of induration of the cord, the affection of both testicles in many instances, the existence of syphilis, and the good effects of anti-syphilitic remedies are the main factors in arriving at a diagnosis. *Hydrosarcocele* has to be distinguished from simple hydrocele; in the latter the testicle becomes enlarged and is generally somewhat tender; the enlargement, however, mainly affects the epididymis, which can be plainly distinguished from the body of the organ. In *hydrosarcocele*, on the other hand, when the fluid has been withdrawn from the tunica vaginalis, the body of the testicle will be felt enlarged and hard, and the epididymis will be obscured altogether; it is only rarely that the amount of fluid in the serous sac is sufficient to render this diagnosis at all doubtful. The swelling of *hæmatocele* usually follows upon an in-

jury and develops quickly; it is, moreover, less nodular and hard than that of chronic orchitis, being elastic or even fluctuating, rarely if ever bilateral, often attains a larger size than an inflamed testicle, and does not yield under anti-syphilitic remedies.

In the early stage, it may be impossible to distinguish *malignant disease* from chronic orchitis; but the continuous and rapid enlargement of the organ, the thickening of the cord, the adhesion of the scrotal coverings, the swelling of the deep inguinal and lumbar glands, and the freedom of disease of the opposite organ, as well as the effects of treatment, will quickly dispel all doubt as to the real nature of the affection. The diagnosis from *strumous orchitis* is very important, and usually it is very easy. In the strumous affection, the epididymis is the first and chief seat of the disease, and this part becomes enlarged and markedly nodular, which is in marked contrast to the slightly nodular and very hard enlargement of the body of the organ in chronic orchitis. Strumous orchitis is much less often bilateral; nodular enlargement of the cord and of the vesicula seminalis of the same side or prostate is common, while tubercular disease of the bladder and kidneys, or of the lungs, only too often renders the diagnosis clear. In strumous disease, the tendency for the inflammatory products to break down into an abscess, is much more marked than in syphilis. *Syphilitic epididymitis*, which occurs early in the course of the disease, and is much rarer than the affection of the body of the organ, will be recognised by the very slow, painless, hard, and bossy enlargement of the globus major, in a patient known to be the subject of syphilis. The chronic orchitis due to gout, malaria, or stricture of the urethra is more general, less nodular, and less hard and painless than that due to syphilis; gummata do not form in connection with it.

The chronic orchitis of infants must be carefully distinguished from malignant disease of the organ, which is also met with early in life. The slow and painless enlargement of the organ, the absence of glandular infection, the affection of both testicles, and evidence of the syphilitic dyscrasia, are points upon which a diagnosis of chronic orchitis may be founded. As in adults, so in infants, hernia testis may result from chronic orchitis.

Treatment.—The treatment of chronic orchitis must be both local and constitutional. Where the disease is syphilitic in origin, and the testicle is considerably enlarged, it should be firmly strapped with

emplastrum hydrargyri or the emplastrum ammoniaci cum hydrargyro. In cases where the enlargement is slight and partial, inunction with mercurial ointment is a better local application, and if there is marked tenderness, unguentum belladonnæ, either alone or combined in equal proportions with ung. hydrargyri, will quickly relieve this symptom. In place of the common mercurial ointment, the ointment of the red oxide or red iodide of mercury, of the strength of ten grains to the ounce, may be used. When inunction is employed, a suspender should be worn. Mercury should also be administered internally in the majority of cases; the drug may be given in any of the usual forms—by mouth, by inunction, or in the form of vapour. Where the patient has not previously had a proper mercurial course, he should be quickly brought under the influence of the drug up to the point of slight swelling of the gums, and this condition should be kept up until all traces of the disease have passed away.

When the patient has been already submitted to a prolonged course of mercury, a milder treatment with the drug will usually quickly lead to improvement. It is a common plan, in such cases, to combine iodide of potassium with the mercury in the form of a biniodide. When the patient has been already thoroughly treated with mercury, and especially when the testicle is affected many years after the primary infection, or when, from the local condition, the disease is believed to be gummatous, and the patient is markedly cachectic, iodide of potassium should be given alone in full and increasing doses, combined with sarsaparilla or cinchona; and when cachexia is marked, cod-liver oil, iron, bracing sea-air, and good food are valuable adjuvants. Mercury is the drug to be relied upon in most cases, and iodide of potassium cannot be successfully substituted for it, unless the patient have been previously thoroughly treated with mercury. For the treatment of hernia testis, see HERNIA TESTIS. When the tunica vaginalis contains only a small amount of fluid, no alteration in the treatment is required, the fluid being quickly absorbed under the influence of mercury; but when the hydrocele is a marked element in the case, greatly adding to the swelling, it is well to tap it, and then to strap the testicle, and should the hydrocele persist after subsidence of the orchitis, the radical cure of the former should be made; this is very rarely necessary. See HYDROCELE. No treatment is of avail where the testicle is atrophied, or

is converted into a mass of dense fibrous tissue.

When, in spite of appropriate local and constitutional treatment, continued for some time, the testicle remains enlarged and hard and is the seat of recurrent attacks of pain, the organ should be removed, as in all probability it is the seat of a chronic abscess. Castration should also be resorted to when the testicle is riddled with chronic sinuses, or is greatly enlarged with gummata, and improvement is not speedily obtained from medicinal treatment. This operation should not be performed until the surgeon is persuaded that the testicle is beyond all hope of recovery; when the syphilitic cachexia is well-marked, the removal of an ulcerated gummatous testicle is often followed by marked improvement in the general condition. Chronic syphilitic epididymitis should be treated by local inunction with mercurial ointment and the internal administration of mercury.

In the few cases of chronic orchitis which are not due to syphilis, the enlarged organ should be carefully and systematically strapped; where there is marked tenderness, *emplastrum belladonnæ* is used with advantage; where the induration is a marked feature in the case, *emplastrum hydrargyri* should be used. If the patient is gouty, the diet and mode of life should be carefully regulated, and alkalies with *colchicum* should be given. When malaria is the probable cause of the affection, removal from the malarial climate—best of all a sea voyage—and the administration of quinine are the most successful measures to adopt. If quinine fails, arsenic should be tried, and iron and cod-liver oil are often of great benefit when the patients are anæmic and thin. When there is a stricture of the urethra, this should be treated. In all cases alike of chronic orchitis, the patients should abstain carefully from alcoholic excess and all forms of sexual excitement.

The chronic orchitis of infants requires the same treatment as that of adults; mercury should be administered internally in the form of grey powder or by inunction of *ung. hydrargyri*, and this ointment may also be applied locally. The little patients are usually cachectic, and require careful feeding and cod-liver oil.

TUBERCULAR DISEASE OF THE TESTIS.—

Causes.—In a large proportion of cases, the disease in the testicle is secondary to tubercular affection of other parts of the body, especially the lungs, bones, kidneys, and bladder; in some of these cases, an attack of acute gonorrhœal epididymitis, or local ex-

posure to cold or injury has appeared to light up the disease in the testicle. In many cases, however, the tubercular disease of the testicle is a primary affection. Tubercle attacks the testicle in the same class of patients and under the same general conditions as other organs, and there is much reason to believe that it is connected with the development of the bacillus tuberculosis. The testicle may be affected in general miliary tuberculosis. The disease is occasionally met with in young children, and is most common in early manhood.

Pathology.—The common tubercular or strumous disease of the testicle consists of a chronic inflammation commencing in the epididymis, and sometimes spreading to the body of the testicle or to the vas deferens. The convoluted tubes of the epididymis become considerably swollen and filled out with cheesy *débris*. The inflammatory products usually undergo a slow caseous change, becoming yellow and friable, and they often, subsequently, soften down into abscesses containing thin pus with curdy or even calcareous flakes. Where the disease is very chronic, the cheesy masses are encapsuled by firm fibrous tissue, and may become calcified. Much more often, however, the inflammation spreads to the surrounding tissues, and the broken-down matters are discharged externally, and a sinus remains which may continue for months, or even years, to discharge a thin flaky pus, and in the more favourable cases may then gradually heal up. The disease most often, but not invariably, begins in the *globus major*, and, as it spreads to the rest of the organ, the tubercular deposit assumes a nodular form, and the separate nodules or masses often undergo their degenerative changes with different degrees of rapidity, resulting in a succession of abscesses and sinuses.

The disease generally spreads along the vas deferens, the walls of which become swollen and thickened, and nodular accumulations of caseous matter may collect in it. From the vas deferens the disease reaches the prostate and the vesicula seminalis of the same side. In these organs similar changes occur. They become enlarged and nodular, and cheesy masses of tubercular matter are found in them; these, like those in the epididymis, may soften down and open into the urethra or bladder, or discharge themselves through sinuses burrowing in the pelvis between the bladder and rectum. From these organs the disease extends to the bladder, and in some cases up along the ureter to the kidney; in the urinary

organs the tubercular deposit quickly ulcerates. From the epididymis the disease often spreads forwards into the body of the testicle, advancing in a regular manner from the mediastinum testis to the front of the organ. Here, the inflammatory products first assume the form of small, firm, grey, pearly nodules or 'granulations,' situated in the lobules of the organ—not in the fibrous septa—which increase in size and number and then coalesce into larger masses, undergoing fatty degeneration, caseation, and softening, as in the epididymis. If abscesses occur the scrotum becomes adherent to the testicle and inflamed, and the pus is discharged externally, and from the opening thus formed a fungous protrusion occasionally occurs. See HERNIA TESTIS.

The rapidity and distribution of the morbid changes vary within wide limits. In all cases alike, the epididymis is first and most severely affected. In some cases, the body of the gland becomes involved early in the disease, large masses of tubercular deposit being found in it; in other cases, the change here is long delayed, and consists of such small deposits of tubercle that they occasion no external sign of their presence. This part of the organ may escape altogether. There is the same variation in the rapidity with which the vas deferens, prostate, seminal vesicle, and bladder become implicated. From the testicle tubercular infection may be carried to distant organs, especially the lungs, and the patient may succumb to general miliary tuberculosis. Similarly, the testicle may show fine grey granulations scattered through the secreting part of the organ, in any case of general tuberculosis. The opposite testicle is often attacked with tubercular disease; in other cases, the body of the unaffected organ rapidly wastes. The tunica vaginalis usually escapes altogether; it may, however, contain an excess of fluid, or its cavity may be partially or completely obliterated by adhesions.

Some difference of opinion exists as to the exact starting point of the tubercular inflammation; probably, it is in the lymphoid tissue that surrounds the tubes. The swelling, in its early stage, consists of a fine nuclear growth in a delicate reticulum, which infiltrates the walls of the tubes and lies in masses between them. The epithelium lining the tubes proliferates, and is shed into and blocks up their lumen. The small vessels in the part become thrombosed or obliterated by the pressure of the new-growth, and, as a result of the gradual diminution of the blood-supply, the inflammatory neoplasia undergoes fatty degene-

ration, and is ultimately converted into a dry granular débris. From more acute processes occurring around these cheesy masses, serum is exuded into them, softening them down into the thin, curdy, flaky pus which is so characteristic of strumous or tubercular abscesses.

Symptoms and Diagnosis.—The origin of the disease is very insidious, and the enlargement of the testicle often reaches some size before it is accidentally noticed by the patient. There is generally no pain or tenderness in the part until the tubercular deposit is softening down into an abscess; the pain then may be only trivial, but sometimes it is severe and is only relieved by the discharge of the pus. The first sign of the disease is a firm nodular enlargement of the epididymis, which generally commences in the globus major and then spreads to the rest of the organ, and forms an irregular crescentic mass behind the testicle. The swelling is firm, unyielding, and usually free from tenderness. The body of the testicle may be quite unaltered, or it may be shrunk and softer than normal, or, at a later period of the disease, a firm lump may be felt in it towards the back and continuous with the enlarged epididymis. The peculiar sensibility of the testicle is preserved, or only lost when the body of the organ is extensively diseased. Hydrocele is infrequent, and, when it is met with, is often partial and slight, being an accumulation of serous fluid in only one small portion of the sac. The cord is full, and early in the disease the vas deferens is felt enlarged—sometimes to the size of a pencil—and nodules may be found in it. The scrotal coverings are unaffected in the earlier periods of the disease.

The nodular enlargement of the epididymis may diminish, and, if calcification of the deposit occur, a very hard callous lump is all that can be detected. More often, the disease slowly but steadily advances, and softening occurs. As the swelling increases, the scrotum is found to be adherent to the contained organ at some one or more places, and it then becomes reddened and projects as a fluctuating tumour which, after a time, bursts and discharges thin pus with curdy or calcareous flakes in it; a sinus remains behind, which gives exit to a thin serous fluid, with occasional flakes of calcareous or cheesy matter. This sinus may heal up: more often it continues open. This process may be repeated at several spots until several sinuses exist, leading down to the epididymis and body

of the testicle, the organ being reduced to an irregular shrunken nodule. As the disease begins and is always most advanced in the epididymis, these abscesses and sinuses are most often found in connection with this part of the organ. Occasionally, a fungous protrusion of granulation-tissue from the testicle may be met with, but this is much less frequent than in connection with syphilitic sarcocele. See HERNIA TESTIS.

The opposite testicle may remain unaffected quite to the last, but often it, too, is diseased in the same manner; while, in some cases, atrophy of the organ is early and rapidly produced. When, as very often is the case, the vesicula seminalis and prostate are implicated, a nodular enlargement of these organs is detected on rectal examination, and the enlarged vas deferens may be felt lying on the inner side of the vesicle, immediately behind the prostate. When the disease spreads to the bladder and ulceration occurs, the patient's distress is greatly aggravated by the frequent painful micturition and the discharge of blood and pus in the urine. The general health of the patient at the same time suffers; he shows the pallor, anæmia, and debility so characteristic of tubercular diseases, and, as a rule, there is evidence of disease of the lungs, larynx, glands, or bones, which may precede or follow that in the testicle. In the later stages, wasting and hectic fever become more and more marked, and lead on to death; but in other cases a generally diffused miliary tuberculosis closes the scene. The existence of grey miliary tubercles in the testicle does not occasion any change in the organ, permitting of the recognition of this form of the disease during life.

The *diagnosis of Tubercular Sarcocele* rests partly upon local and partly upon constitutional signs. The local signs to be specially noted are the slow, painless, nodular enlargement of the epididymis, which only late, if at all, spreads to the body of the testicle, the preservation of the special testicular sensibility, the thickening and nodular swelling of the vas deferens, and the enlargement of the seminal vesicle on the same side, and often also of the prostate. Later on, these nodular masses tend to adhere to the scrotum, and break down into abscesses and leave sinuses discharging thin sero-pus. The site of the disease distinguishes it from chronic orchitis; the chronic syphilitic epididymitis, which is sometimes met with, has no tendency to soften into an abscess or to gradually spread and involve the rest of

the organ, while it is accompanied by other evidences of secondary syphilis. Tubercular orchitis is rare in childhood and old age; and the frequent concurrence of phthisis, or of tubercular disease of glands, bones, or joints, together with the delicate appearance and general health of the patient, are the constitutional phenomena leading to a correct diagnosis.

Treatment.—When the disease is limited to the testicle, and there is no evidence of tubercle in any other part of the body, the diseased organ should be removed at the earliest possible moment, and afterwards care should be taken to place the patient in the most favourable hygienic conditions. Should the disease recur in the opposite testicle, the surgeon must not hesitate to remove it also, provided the disease be limited to that organ; and, if a patient present himself with tubercular disease of both testicles, but be free from tubercle of other organs, both testicles should be at once removed. The necessity for this prompt and radical treatment arises from the tendency of the disease to spread to the urinary organs, infect the lungs or other distant organs, or form the starting-point of generally disseminated tuberculosis. Unfortunately, owing to the insidious origin and slow painless course of the affection, it is rare for the patient to come under treatment at this early stage, while, in many cases, the disease in the testicle is secondary to disease in the lungs and other organs. Should the seminal vesicle or prostate be already enlarged and indurated, castration is not to be recommended.

In the more frequent case of disease of the testicle associated with tubercle in other organs, the best results will be obtained from careful attention to the general health. The patient should, if possible, reside at the seaside for a prolonged period, or, better still, take a long sea voyage. His diet should be carefully regulated, and cod-liver oil should be taken in such quantity as can be well borne. Other tonics, especially the iodide of iron, arsenic, and quinine, will be found useful under the varying conditions of the patient's appetite, &c. The testicle should be carefully suspended, and painting the scrotum with tincture of iodine, or inunction with an ointment containing ten grains of iodoform to the ounce or the ung. plumbi iodidi, appear to be useful. When there is local pain and tenderness, belladonna ointment may be advantageously substituted. Rest in the recumbent position must be maintained as much as possible. Sexual excitement should be entirely

avoided, and riding or violent exercise of any kind is equally harmful, although a gentle daily walk, short of producing a sense of fatigue, is a valuable adjunct to the general treatment.

When it is evident that the tubercular deposit has softened down, and fluctuation is detected, an incision should be made into the abscess, and if this subside into a sinus discharging a little sero-pus, the surgeon should content himself with keeping the part clean and injecting tincture of iodine into the sinus from time to time. When, however, the suppuration is more abundant, and fresh abscesses form, and particularly when the testicle is the chief seat of the tubercular disease, or the changes in it are believed to be the main cause of the constitutional condition, more active measures should be taken. The best plan is to enlarge a sinus and, through the wound thus made, to scrape out all the cheesy deposits by means of a sharp spoon. Care should be taken to do this thoroughly, as the success of the measure largely depends upon the removal of all the degenerated tubercular material. The cavity left should be stuffed with iodoform gauze, or powdered iodoform and salicylic silk, and allowed to close by granulation. When the disorganisation of the body of the testicle is so advanced that castration would be a simpler procedure, it should be preferred. The removal of the tubercular deposit, if completely executed, affords good results and is not a serious procedure, and it should certainly be undertaken in preference to castration when the degenerative changes are limited to the epididymis.

IRRITABILITY OF THE TESTIS.—Under this name are included cases of undue sensibility of the testicle.

Causes.—While the organs are undergoing their normal development at puberty, they may become hyperæsthetic; a more frequent cause of this condition is onanism, or excessive sexual indulgence, and in some cases the pain is traceable to prolonged but ungratified erotic excitement. Varicocele may be associated with 'irritable' testicle, and an atrophied testicle—whatever the cause of the wasting—is often the seat of excessive sensibility. More rarely, the affection appears to depend upon abscess or irritability of the prostate gland and prostatic urethra. In many cases there is no local cause for the malady, and such patients are generally weakly anæmic men, or are the subjects of dyspepsia.

Pathology.—There is no known pathology of this condition; in some cases the

testicles, apart from any of the above local conditions, are rather soft and flabby.

Symptoms and Diagnosis.—The patients complain of an extreme sensibility of one or both testicles, often most marked in the epididymis. This may be so great that the movements of walking, the contact of the dress, or the gentlest digital examination, excites acute pain. The affection is often bilateral, and when it affects one testicle only is more frequent on the left side. If the patient is at rest, and particularly if the scrotum is suspended, there is no spontaneous pain. The organs are at the same time free from all obvious and coarse painful lesions, such as inflammation and new-growths. The diagnosis of irritable testicle is very readily made, but pains must be taken to determine its cause, as only when this is known can treatment be adopted with confidence and success.

Treatment.—In all cases a well-fitting suspender should be worn, either next the scrotum or over a layer of cotton-wool, and cold douches to the part are generally beneficial. Where the changes of puberty are supposed to be the cause, patience must be exercised, and the application of belladonna liniment or ointment may afford relief. All sexual abuses must be stopped, and in some cases the sedative influence of bromide of potassium is very valuable, while in other instances the regular sexual relation of marriage removes the morbid sensibility of the testicles. Where there is varicocele or disease of the prostate, appropriate measures must be taken to cure these conditions. Strict attention should be paid to the diet and the state of the digestive organs, and, where there is anæmia, iron should be administered. In all cases it is important to allay the patient's fears of impotence or sterility, or of the existence of serious organic disease of the parts, and he should be assured of the perfect curability of his disease. Healthy bodily and mental employment should be found, and efforts should be made to distract his thoughts from his sexual organs and all allied subjects; in this way travel will often be found useful. Castration should never be resorted to for this condition.

NEURALGIA OF THE TESTIS.—This affection is characterised by recurrent attacks of severe pain in one or other testicle.

Causes.—Many causes of neuralgia of the testis are known, but in some cases it is quite impossible to assign any cause for the pain. Among constitutional causes, malaria, gout, and anæmia are the best ascertained. Among local causes must be

cited injury to the spermatic cord and nerves, a recent attack of orchitis, obstruction of the vas deferens or duct of the epididymis, a chronic abscess of the testicle, and severe injury to the testicle as by a bullet wound. Malignant disease of the spine affecting the upper lumbar nerves, calculous pyelitis, or the passage of a calculus along the urethra, are conditions which produce true neuralgia of the testicle, evidently through the agency of the spinal cord and nerves.

Pathology.—The pathology of neuralgia of the testicle is not known. In some cases the organ is fuller and plumper than normal, and it is stated to become actually inflamed as the result of neuralgia. Where the pain follows upon injury or inflammation of the part, it may be due to bulbous enlargements of the ends of branches of the spermatic nerves, or to compression of these nerves by contracting cicatricial bands.

Symptoms and Diagnosis.—The affection is characterised by the occurrence of intermittent attacks of severe pain in one testicle (very rarely both), which may be limited to the testicle or shoot up along the spermatic cord. These attacks of pain may recur at regular intervals, or quite irregularly, and they are independent of movement or friction of the testicle. When the pain is severe, the testicle is generally sharply retracted, being drawn quite up to the abdominal ring. Associated with the pain there is sometimes marked local tenderness—a condition of ‘irritability’ of the organ. In some cases the attacks of pain are excited by sexual excitement, particularly if there be obliteration of the duct of the testicle. Neuralgia of the testicle is easily distinguished from irritability of the organ by the paroxysmal character of the pain, and its spontaneous occurrence, apart from contact or friction. In every case a patient attempt to elucidate the cause of the pain must be made.

Treatment.—If there is any reason to suspect the influence of malaria, quinine should be freely administered, and if it fail to relieve, arsenic should be tried; if the patient be anæmic, iron and cod-liver oil are indicated, while if there be any signs of gout or lithæmia, the diet should be carefully regulated and alkalies be freely administered. Very great care should be taken to have the patient’s constitutional condition as healthy as possible. Nothing is definitely known of the value of aconite, belladonna, phosphorus, and other neuralgic medicines administered internally. Locally, the testicles should be suspended, and cold douches,

or the application of equal parts of aconite and belladonna ointment to the scrotum will be found beneficial. The injection of a small quantity of morphia (gr. $\frac{1}{4}$ – $\frac{1}{8}$) into the testicle or into the loose tissues of the cord is the surest means of relieving the pain. Varicocele should be submitted to operation for its radical cure. Counter-irritation of the scrotum or along the cord by iodine or the Spanish fly may be quickly successful in some cases. When the neuralgia owns some distant cause, the treatment must be directed to the cure of that affection—e.g. renal calculus. When, however, all these general and local measures fail, and the pain is severe, and there is reason to think that the cause of the trouble is some condition of the testicle or cord, castration may be performed. This should only be resorted to in very rare instances and under the above conditions, and should never be pressed upon the patient. If the testicle is removed, and the actual cause of the pain is not at the same time removed, the pain recurs in the spermatic cord.

TUMOURS OF THE TESTIS.—Causes.—Injuries of the organ, blows and squeezes, are often the apparent starting-point of malignant tumours of the testicle; but in a large number of cases there is no history of previous injury or inflammation, or any circumstances of etiological importance. Dermoid tumours of the testicle are congenital in origin. Age exerts an important influence upon the development of the other forms of new-growth; sarcoma occurs most often before ten years of age, and between the ages of thirty and forty; carcinoma probably never occurs in children, and is most often seen between the ages of thirty-five and forty-five; pure enchondroma of the testicle is met with in young adults.

Pathology.—The commonest tumours of the testicle are sarcoma and carcinoma; of the former, round-cell, spindle-cell, mixed-cell, and lympho-sarcoma or adeno-sarcoma are met with. Carcinoma occurs as encephaloid, and possibly also as scirrhus. The naked-eye appearances of these two classes of tumours may very closely resemble each other. They may each of them occur as soft, pinkish-grey tumours, with patches of yellow and red from fatty degeneration and hæmorrhage. Sarcomata, however, vary much in their appearance; they may be firmer, being traversed by coarse bands of fibrous tissue, or contain nodules or larger masses of pearl-like cartilage. The cartilage may exist in small amount, may form branching pieces

which are believed sometimes to lie in dilated lymphatics, or nearly the entire mass of the tumour may be converted into cartilage, a thin layer of softer material being the only indication of the sarcomatous nature of the tumour. Along with cartilage, myxomatous tissue, and sometimes also striped or unstriped muscle-fibre, may be found.

Cysts are frequently found in these malignant tumours of the testicle. They are more frequent in sarcomata than in carcinomata. In number and size they vary within wide limits—at times only few and small, at other times they form the greater bulk of the tumour; and cystic tumour of the testicle has been described as a distinct variety of new-growth. This term, however, should only be applied to the very rare hydatid and dermoid cysts of the testicle, for in the multiple cystic tumours, sarcomatous tissue, or more rarely carcinoma, is always to be demonstrated between the cysts. The greater number of such cysts are smooth and lined with epithelium, and are developed from the tubules of the rete testis; others of them are irregular, with a flocculent surface, and are formed by the softening of the tumour-tissue or the occurrence of hæmorrhages into it. The former contain pale or variously coloured turbid fluid, and intracystic sarcomatous growths are frequently found in them.

Carcinoma starts in a proliferation of the epithelium lining the seminal tubules; sarcoma, on the other hand, begins in a cellular proliferation between the tubules, which pushes them aside, and remnants of the tubes can often be traced in large sarcomatous growths. These diseases most often start in the body of the testicle, the secreting structure being gradually replaced by the neoplasia, and the epididymis may remain unattacked for a long time. The resisting tunica albuginea at first yields very slowly before the new-growth, but, in actively growing tumours, the soft tissue may fungate through it into the scrotal coverings, and, these becoming involved, ulcerate, a fungus hæmatodes resulting. From the testicle the new-growth may spread up along the cord for a varying distance; but apart from this, owing to the extreme vascularity of these growths, both the spermatic artery and veins are enlarged, and make the cord feel full. Malignant disease is usually unilateral, but sarcoma may attack both testicles. Sarcoma has also been found growing from the visceral layer of the tunica vaginalis,

and surrounding the testicle. Hydrocele, even to a considerable extent, may be added to the enlargement of the testicle itself when attacked with malignant disease.

Secondary growths, whether of sarcoma or carcinoma, are met with in the deep inguinal, iliac, and lumbar glands, and, when the scrotum is affected, the superficial inguinal glands also become infected. The abdominal growths are of the same nature as those in the testicle, and often attain a very large size, and press upon and invade the aorta, vena cava, iliac vessels, or the spine, and may spread to the kidney, liver, and lungs, and from thence to more distant parts. Pure enchondroma, in the form of a rounded or lobulated tumour within a fibrous capsule, and without any softer sarcomatous tissue, is occasionally met with. This form of tumour is not malignant, occurs in young persons, and is of very slow growth. Some cases of so-called fibroma of the testicle are, in reality, spindle-cell sarcomata, which have, to a large extent, developed into fibrous tissue; very rarely pure fibroma, a benign growth, has been met with. Dermoid cysts have been found to contain cartilage and bone, and sometimes an oily fluid which solidifies on cooling. Their origin is variously explained as due to foetal inclusion, to partheno-genesis, or to *hétéropie plastique*.

Symptoms and Diagnosis.—The symptom of a tumour of the testicle is a chronic continuous enlargement of the organ which resists all local and constitutional treatment. It may be first noticed soon after an injury, but more often its origin is quite insidious. It commences in the body of the organ, and quickly obscures the outline of the epididymis, but the ovoid shape of the gland, and its smooth contour, may be long retained. The rapidity of the enlargement varies greatly both in different cases and in the same case at different times. In the one case, the difference depends upon the lower or higher grade of organisation of the neoplasia; in the other, it may be due to the restraining influence of the tunica vaginalis in the early stage, or to some alteration in the nature of the tumour, as when a chondrifying sarcoma ceases to organise into cartilage, and grows as a pure sarcoma. In the early stage the swelling is firm, even hard; but as it grows it may become softer, or, what is very characteristic, of unequal consistence in different parts; and along with this the regularity of the surface is lost. The more malignant tumours may attain an enormous size before death puts an end to their growth.

The scrotal coverings are at first stretched over the included tumour, and dilated veins course under the skin; later on the tumour becomes adherent to and implicates the skin; ulceration then quickly occurs, and allows the malignant growth to fungate, the fungus having all the characters of the well-known fungus hæmatodes; this is now rarely seen, as the organ is usually excised before this stage is reached. The front part of the swelling fluctuates if there is vaginal hydrocele. The cord is full from the increased size of the spermatic vessels, and in many cases it becomes enlarged and indurated from the tumour spreading up along it to the inguinal canal. The growth in the early stage is usually quite or nearly painless, and the characteristic testicular sense is early lost. The lymphatic glands, just above Poupart's ligament, are soon felt enlarged, and, from these, other lumps may be felt running up along the iliac vessels and in front of the lumbar spine; when the scrotum is implicated, the superficial glands of the groin are also enlarged, and in rare cases this is observed before there is any appreciable adhesion of the tumour to its scrotal coverings. With the growth of these glandular tumours there may come on œdema of one or both lower limbs. Enormous growths may occur in the abdomen, and in other parts. The patient at length dies from exhaustion, worn out by pain, discharge, and semi-starvation, or the special effects of certain local secondary deposits.

Tumours of the testicle have to be *diagnosed* from hydrocele, hæmatocele, chronic orchitis, and tubercular disease. The pyriform shape of the tumour, its translucency and fluctuation, usually at once distinguish *hydrocele*; when, however, the tumour is opaque from thickening of the wall, and the sense of fluctuation is obscure, reliance must be placed upon the detection of the testicle by its special sensibility, and the absence of change in the cord and lymphatic glands. Where doubt exists, it may be cleared up by an exploratory puncture, or, better, an incision. *Hæmatocele* is distinguished from tumour by its sudden onset after injury, often by its fluctuation, and also by the detection of the testicle in the mass by its special sensibility to pressure; the steady persistent growth of a tumour, its unequal consistence, the enlargement of the cord and lymphatic glands, are other points assisting in the diagnosis. Cases do occur, however, in which an exploratory puncture or incision is necessary to render the

diagnosis certain. From *chronic orchitis* a tumour will be distinguished by the absence of the causes of inflammatory enlargements of the testicle; by the persistent, often rapid, enlargement of the organ, in spite of all treatment; by the inequality of the consistence of the tumour in many cases, and by the enlargement of the cord and lymphatic glands. When doubt is entertained, the system may be brought rapidly under the influence of mercury, and if, in spite of this, the growth continue, its malignant nature may be considered certain. *Tubercular disease* will be distinguished from tumour of the testicle by the early and marked swelling of the epididymis, the tendency to softening, and in many cases the presence of tubercle in other organs.

When the tumour has reached a great size, and the scrotal veins are much enlarged, or a mass of the growth fungates through the skin, there should be no difficulty whatever in arriving at a diagnosis. In the more malignant growths, the rapidity and persistency of the enlargement, the early loss of testicular sense, and the impossibility of detecting the testicle in the mass of the tumour, together with enlargement of the cord, are the most important diagnostic signs before glandular infection occurs. In benign tumours, the extreme chronicity of the enlargement, and its hardness or bossy outline, may at once afford ground for a correct diagnosis.

To distinguish between the different varieties of tumour is not always possible; but the following rules are of value. A rapidly-growing tumour, in a child, is certainly sarcomatous. A malignant tumour attacking both testicles is a sarcoma. A malignant tumour, in an adult, may be either sarcoma or carcinoma, but a uniformly rapid growth, with early and marked enlargement of the spermatic cord and lymphatic glands, points to carcinoma. A preliminary period of quiescence or of slow growth, with a sudden accession of activity and very rapid growth, is in favour of a tumour being a chondrosarcoma. A very gradual, painless enlargement of the testicle, forming a smooth ovoid tumour, without enlargement of the cord or lymphatic infection, indicates a cystic sarcoma. Sometimes, one or more of the cysts may project from the surface, and if, on tapping such a tumour mucoid fluid is withdrawn, the diagnosis becomes assured; this form of tumour is generally met with between the ages of twenty and forty. Great hardness of a

steadily-growing tumour occurring after forty years of age, with enlargement of the cord and lymphatic glands, would point to scirrhus. A slowly-growing tumour of great hardness, with a smooth oval or bossy surface, without implication of the cord or glands, and occurring in a man before thirty years of age, is probably a simple enchondroma; such a tumour may attain a very great size. A fibroma cannot be diagnosed with any approach to certainty; like enchondroma, it is of very slow growth and extremely hard, and destitute of all signs of malignancy. A dermoid cyst is to be recognised by the congenital nature of the tumour (if the history be known), by a more or less globular outline, by inequality of consistence—at places being solid, at others fluctuating; if such a tumour be tapped and oily fluid escape, the diagnosis is still more certain. As already noticed, tapping a cystic tumour may lead to the escape of characteristic fluid; in other cases this affords information of the density of the tumour. Both sarcoma and carcinoma bleed very freely; enchondroma and fibroma are much less vascular.

Treatment.—The only treatment of avail, for any case of tumour of the testicle, is removal of the diseased organ. In the rare cases of benign tumours this question presents no difficulty. In malignant tumours, it is most important to perform castration at the earliest possible moment, and certainly before the lymphatic glands are enlarged, or the cord is involved in the disease higher than the external abdominal ring, or the tumour is adherent to the scrotum. The spermatic cord should be divided as high as possible above the disease. In the rare cases of sarcoma affecting both testicles, the two organs should be removed. Only too frequently, when the patient is seen, the cord is enlarged quite up to the internal ring, and secondary deposits are already to be felt in the iliac or lumbar glands. In such cases, the operation cannot be done with any view of curing the patient; but if the tumour of the testicle be a great annoyance to the patient from its bulk or weight, or from the presence of a foul fungating sore, it may be removed simply as a palliative measure. Even when the surgeon operates early, he is only too often disappointed by rapid recurrence of the disease in the stump of the spermatic cord or in the abdominal glands.

But there is no doubt that operation, when performed in suitable cases, affords a chance of cure, and a certainty of immu-

nity from disease for a time, and often for a considerable time. *See* CASTRATION.

A. PEARCE GOULD.

TESTIS, Injuries of the.—*Causes.*—The extreme mobility of the testicles protects them from injury, but they are not infrequently contused by blows against the pommel of the saddle in riding, by being struck in fighting, cricket, &c., or by squeezes between the thighs. The testicle is much more rarely wounded; it may be punctured in tapping a hydrocele or hæmatocele, lacerated by a gunshot or other projectile, and, occasionally, self-inflicted wounds of this organ come under the notice of the surgeon.

Pathology.—In contusion of the testicle, blood is often effused between the tunica vaginalis and the tunica albuginea, and up along the cord, and in severe cases this effusion has been found to extend even up to the kidney. Hæmorrhage also occurs into the substance of the organ, and hæmatocele may be superadded. The injury may excite acute inflammation: when less severe, it may be the exciting cause of chronic orchitis, of hydrocele, or of malignant disease. Atrophy of the testicle frequently follows traumatic inflammation of the organ, and severe contusion of the testicles is a recognised method of producing sterility. Division of the tunica albuginea may be followed by protrusion of the seminal tubes, but not to any great extent, unless inflammation be set up. Gunshot wounds of the testicle are very frequently followed by atrophy of the organ.

Symptoms.—Sudden death has been caused by a severe injury to both testicles. The immediate symptoms of contusion of the testicle are a severe pain in the part extending up along the groin to the loin, with acute tenderness and general pallor, nausea, vomiting, and faintness, even to complete syncope. In favourable cases, the constitutional effects are soon recovered from; the testicle and cord remain tender for a few days, and then all symptoms pass away. In other cases, the symptoms of acute orchitis quickly set in, or chronic orchitis or hydrocele may come on at a longer interval, or, still later, a tumour may develop in the testicle.

A wound of the testicle is attended with similar sickening pain and faintness. When made in tapping a hydrocele, blood escapes with the serous fluid or collects subsequently in the tunica vaginalis (*see* HÆMATOCELE), or a small tender nodule may be detected on the surface of the gland. When impli-

cated in a severe wound of the scrotum, the organ is usually exposed; the tubules may not project at all, or they may bulge outwards in the form of a soft grey nodule.

Treatment.—After a severe contusion, the patient should be put to bed, and the testicle supported on a soft pillow or a broad strip of plaster fastened across the thighs, and an ice-bag applied. When less severe, it may be sufficient to rest for a few hours and to wear subsequently a suspender. When a testicle is wounded with a trocar, the patient should be confined to bed and an ice-bag applied. If the testicle is wounded by a knife, great care should be taken not to draw out any of the tubular structure, but, the part having been carefully cleaned, the edges of the incised tunica albuginea should be united with a continuous suture of fine catgut. Contused and lacerated wounds cannot be thus treated, but the usual surgical rules must be complied with. The surgeon should not remove the injured organ unless it is beyond question that the entire gland is disorganised, and every effort should be made to secure rapid healing of the part. Neuralgic pain is often complained of after gunshot and similar injuries of the testicle. *See* TESTIS, Diseases of the. A. PEARCE GOULD.

TESTIS, Malpositions of the.—There is no sufficient evidence that a supernumerary testicle has ever been met with—the supposed cases of this deformity being instances in which an encysted hydrocele, or a fatty or fibrous tumour, has been mistaken for a third testicle. One or both testicles may be entirely absent; but this condition can only be proved by dissection, as mere inability to find the organs during life cannot be accepted as evidence of their non-existence. Absence of both testicles (anorchism) is usually associated with other deformities in the sexual apparatus. In cases of ‘retained testis,’ the epididymis and lower end of the vas deferens may be found in the scrotum and separated from the imperfectly descended body of the testicle. The epididymis may also be the only part of the organ developed, occupying its usual position in the scrotum, the body of the organ being entirely absent, or represented by a small pea-like nodule of tissue. Another important deformity is a congenital absence of part or of all, or closure of either end of the vas deferens. This condition does not interfere with the structure of the testicle, which is plump and of its usual size; but of course its secretion does not reach the urethra. The develop-

ment of the testicle, which usually takes place at puberty, may be delayed for a time or fail to occur altogether. The writer believes that this is in some cases (unilateral) associated with and perhaps caused by varicocele; in other instances (bilateral) the subjects of it are generally ill-developed and effeminate in appearance. Absence or non-development of one testicle may be accompanied by hypertrophy of its fellow.

The commonest malposition is that known as *inversion of the testicle*, in which the organ is rotated so that the epididymis is towards the front of the scrotum, and the body of the organ, with the tunica vaginalis, is directed backwards. This condition is easily recognised by the hand, which notices also that the vas deferens is in front of the other constituents of the cord. Inversion is frequently to be seen on one or both sides, and it is of considerable importance in hydrocele, hæmatocele, and epididymitis. In the two former, the testicle will be in front of the fluid in the tunica vaginalis, and may be wounded in the operation of tapping or incising unless its position be previously ascertained. In the latter, the painful swelling may be mistaken for inflammation of the secreting part of the gland: its shape, and the configuration of the back of the organ, as well as the condition of the cord, will lead to a correct diagnosis. A condition of *partial inversion*, in which the epididymis is directed towards the thigh, is very occasionally met with. *Reversion of the testicle* is the name given to the state in which the top of the testicle with the globus major of the epididymis is at the bottom of the scrotum, and the vas deferens comes off from the highest part of the organ.

DELAYED DESCENT OF THE TESTICLE.—Instead of being in the scrotum at birth, the testicle may not descend until months or years afterwards. If the organ do not pass into the scrotum within the first few months after birth, its descent is generally delayed until puberty, accompanying the full development of the organ. In nearly all cases of descent after the age of one year hernia occurs, and in many instances the intestine is adherent to the testicle.

INCOMPLETE DESCENT OF THE TESTICLE.
RETAINED TESTIS.—1. *Etiology.*—Many conditions may interpose to prevent the complete descent of the testicle. Those best known are a fusion of the two testes (synorchism), a long mesorchium, intra-peritoneal adhesions, a weak gubernaculum testis, and a small external abdominal ring. Other alleged causes are shortening of the

vas deferens, large size of the epididymis, and the pressure of a truss causing the gland to become fixed in the iliac fossa or inguinal canal. A testicle, which has completely descended, has been known to be drawn up into the inguinal canal and permanently retained there. See *Retraction of the Testis*.

2. *Pathology*.—The testicle may be of full size, plump, and presenting all its normal appearances when examined microscopically; in the majority of cases it is small and flabby, and it is impossible to draw out the seminal tubules as in a normal testicle. The epididymis may be quite normal, or it may show the same changes as the body of the organ, but to a less degree; but it is sometimes more or less separated from the secreting part of the gland, and may descend into the scrotum while the body of the organ is lodged in the inguinal canal. The epididymis has been found abnormally large. The testicle may be either movable in its serous covering, or more or less firmly fixed by adhesions which tend to increase as attacks of inflammation are repeated. The development of the gland, which should occur at puberty, as a rule does not take place. The vas deferens is generally found of its usual length, and coiled up in the belly; very rarely it is shortened. The scrotum may be quite normal in appearance, but is generally small and undeveloped on the affected side; it may contain only fatty tissue, but in some cases a serous sac is found in it. The serous sac surrounding the testicle may be shut off, but, as a rule, it communicates freely with the peritoneal cavity. Adhesions may be found passing from the testicle to one or more of the adjacent abdominal viscera, or the testicle may be found free in the peritoneal cavity, attached posteriorly by a long mesorchium. A hernia is very commonly associated with 'retention' of a testicle, and in such cases the coil of intestine may be firmly adherent to the top of the gland. The testicle may lodge at any spot between the kidney and its normal position in the scrotum; most often it is retained in the inguinal canal, and its next most common seat is in the iliac fossa, close above Poupart's ligament. In the latter situation it is more protected against injuries of all kinds than in the former, and is therefore less often the seat of inflammation, and the gland is more often plump and well-nourished than in the inguinal canal. As a general rule, a retained testicle is a sterile organ, but to this there are exceptions. The only way of accurately determining this

important point is to examine the secretion of the gland for spermatozoa.

3. *Symptoms, Complications, and Diagnosis*.—There may be no symptoms occasioned by this deformity, and the patient's attention is drawn to his condition only by the empty state and small size of the scrotum, on one or both sides. When the testicle slips freely along the inguinal canal, it is apt to be nipped by the external abdominal ring, with the production of severe pain or of repeated attacks of inflammation. In the more common cases, in which the gland is more fixed in the inguinal canal, its liability to injury leads to attacks of inflammation. The diagnosis will be made by noticing the absence of the testicle from the scrotum, which is usually small or obviously asymmetrical, and by detecting the gland in the inguinal canal or in the iliac fossa, close above Poupart's ligament. The outline of the testicle may be quite distinct and unmistakable, or obscured by the thickening left by attacks of inflammation; the character of the pain caused by manipulation of the part will aid in the identification of the testicle.

The complications of retained testicle are hernia, including strangulated hernia, epididymitis, hydrocele, and malignant disease. The hernia may consist of a knuckle of intestine or a piece of omentum above the testicle, or the protruded viscus may fill the tunica vaginalis, obscuring the testicle, or may even pass on in advance of it into the scrotum, and then great care will be required to recognise the true condition. The presence of a hernia in addition to the retained testicle will be decided by the general characters of the swelling (*see GROIN; SCROTAL SWELLINGS*), especially by the feel, reducibility, and resonance on percussion of the swelling, and by a gurgle on manipulation. Strangulation of the hernia causes the usual signs of that condition. Acute epididymitis which follows blows or strains, or comes on in connection with inflammation or irritation of the prostatic urethra, is characterised by a very painful tender swelling of the part, with more or less redness of the skin over it, without impulse on coughing, accompanied by fever, and often nausea and constipation—sometimes vomiting. An effusion of blood may occur in the scrotum, and render the diagnosis more difficult. It may be mistaken for a strangulated hernia; but the diagnosis will be made by attention to the history of the case, and by observing the acute local pain and tenderness in epididymitis, with fever but with-

out absolute constipation; in strangulated hernia the pain is less acute, and is generally referred to the umbilicus, local tenderness is less marked, the constipation is absolute, and the general symptoms are those of collapse. For hydrocele around a retained testicle *see* HYDROCELE, Inguinal. Retained testicles are particularly liable to be attacked by malignant disease, owing to their exposure to repeated injuries and attacks of inflammation. For the diagnosis of this condition *see* TESTIS, Diseases of the.

4. *Treatment*.—Where the testicle is lodged deeply in the belly, no special treatment is required. When the testicle is placed close above the internal abdominal ring, a carefully-adjusted truss, which will prevent the descent of intestine without pressing upon the gland, is required. If the testicle be in the inguinal canal, but can be protruded beyond the external abdominal ring, a truss which will press it down and at the same time overcome the tendency to hernia, should be worn: a horseshoe-shaped pad is recommended in such cases. Where the testicle occupies the inguinal canal and can neither be pushed up nor down, a truss should not be worn, as the pressure of the pad upon the testicle excites pain, and may cause inflammation. Acute inflammation must be treated in the usual way (*see* TESTIS, Diseases of the); but when a testicle has been the seat of repeated attacks of inflammation, it should be excised, as it is in all probability functionally useless, as well as inconvenient, and very liable to become the seat of malignant disease. When there is a hernia present, and a truss cannot be worn or fails in its object, an operation should be undertaken to close the neck of the hernial sac and bring the pillars of the ring closer together. At the same time the testicle must be removed from its bed. If the gland is small, flabby, and evidently useless, it should be excised; but if the gland be plump and of good size, and not adherent or otherwise injured by inflammation, it should be freed from its position, and after a cavity has been cut for it in the scrotum, it should be fixed there by catgut sutures, and the superficial wound united in the ordinary way. Should the vas deferens be shortened, this procedure will be impracticable. The wound should be treated aseptically, as much of the success of the operation depends upon obtaining primary union throughout. It should not be undertaken in children under two years of age, nor in elderly persons, nor where the scrotum is so small that it cannot easily

lodge the testicle. *See* HERNIA, Radical Cure of.

When, in operating for strangulated hernia, a retained testicle is exposed, it should be excised. Should the testicle become the seat of malignant disease, excision is to be practised at an early period; but the operation is not so successful as ordinary castration, both on account of its own peculiar dangers, and because it is impracticable to divide the spermatic cord sufficiently high above the disease. If the lumbar glands are infected, as indicated by the presence of a tumour in the iliac fossa, or by pain along the lumbar nerves, or by œdema of the lower limb, the operation should not be performed. When the gland is in the inguinal canal, an oblique incision must be made from over the internal abdominal ring to the root of the scrotum, the external oblique should be divided on a director, and then the testicle is to be freed from its bed, and the cord tied as high up as possible; a drain should be laid in the wound, which is to be then sewn up. The external oblique muscle may be absent over the tumour, which then lies superficially. In the case of malignant tumour of the testicle retained within the belly, the operation of excision may be performed by a free vertical incision immediately over the mass, or by a median incision in the linea alba; experience is not yet sufficient to determine which of these methods is the better.

If consulted as to the propriety of marriage in cases of this deformity, the surgeon must remember that retention of one testicle—the other being sound—is no bar to fruitful marriage. Where both testicles are retained, all the facts bearing on the sexual powers of the patient must be carefully weighed. If the penis be small or ill-formed, or if there be an absence of sexual desire or of sufficient erections, and if with these signs there be an effeminate appearance—absence of beard, a heaping up of fat over the pubes, long, fine, silky pubic hair—marriage should be forbidden. Should there be all the usual signs of virility and the patient is the subject of sexual desire, he should be told that, although capable of sexual intercourse, he is almost certainly sterile; and if on examination of several specimens of the fluid of an emission no spermatozoa are found, the fact of his sterility may be considered as beyond doubt. Under these circumstances, it does not lie with a surgeon to determine the propriety of marriage.

ABNORMAL DESCENT OF TESTICLE.—Instead of passing into the scrotum, the tes-

ticle may, after passing the external ring, slip down towards or into the perineum—*ectopia perinealis, testis in perineo*—or it may take an altogether irregular course and escape from the belly through the crural canal—*ectopia cruralis*. The cause of this deformity lies, probably, in some abnormality in the lower attachment of the gubernaculum testis.

Pathology.—*Ectopia perinealis* is much more common than the crural form. In it the testicle lies either in the furrow between the thigh and the scrotum, or in the anterior part of the perineum in front of the anus and to one side of the median line. The spermatic cord can be traced to it, and the organ presents its usual characters. In *ectopia cruralis*, the testicle may occupy the crural canal, or, passing beyond it, may present in the saphenous opening, forming a superficial tumour in the groin. In these cases there is a tendency to the development of a femoral hernia. The scrotum is usually small on the affected side, and of course empty.

Symptoms, Complications, and Diagnosis.—A testicle in the perineum is much exposed to injury in sitting, riding, &c., and is consequently the seat of repeated attacks of inflammation, and a great source of annoyance to the patient. The association with hernia is the most serious sequel of crural ectopia. The diagnosis will be made by noting the absence of the testicle from its proper position, the non-development of the scrotum (in most cases), and the general characters of the swelling caused by the misplaced organ. When inflamed in the perineum, it might be mistaken for a perineal abscess; in the groin it might be mistaken for a bubo or a strangulated hernia.

Treatment.—*Ectopia perinealis*. In early infancy no treatment is required. If the scrotum is well developed, an attempt should be made to fix the testicle in it, and this is most likely to be successful after two years of age and before puberty, when the child is of an age to admit of the successful application of antiseptic dressings. An incision is to be made over the spermatic cord, which is to be freed, and the testicle is to be drawn up from the perineum, any firm adhesions being divided with the knife. The wound is then to be prolonged into the scrotum, and the testicle fixed in place with catgut stitches. The cavity in the perineum left by the testicle is to be opened behind and a drainage-tube inserted, and then the wound in the groin and scrotum is to be carefully stitched up. Every precaution should be taken to render and

to keep the wound aseptic, and to secure primary union. Should the scrotum be undeveloped it is of no use to attempt this operation, and after the age of puberty the prospect of success is so small as to render the attempt scarcely justifiable. Under these circumstances, the patients can sometimes be relieved by the application of a pad, which pushes aside the testicle into a place where it is less exposed to injury. If this fail, the misplaced organ should be excised.

Ectopia cruralis. If the testicle is reducible into the belly, a truss, as for femoral hernia, should be worn. Where irreducible, a truss with a hollow pad to fit over and protect the testicle should be tried. If this fail to prevent attacks of inflammation or contusion of the gland, or if there is a femoral hernia associated with the misplaced testicle, the gland should be excised, and the neck of the serous sac carefully stitched up, to prevent or to cure a tendency to hernia.

RETRACTION OF THE TESTIS.—*Causes.*—The most frequent cause of retraction of the testicle is calculous disease of the kidney, or the passage of a renal calculus along the ureter. It may also arise from irritation of the urethra, especially of the prostatic portion, and from injury to the groin and pubes. In some cases it has followed acute inflammation of the body of the organ; in others it has been found impossible to assign a cause for the condition.

Pathology.—The retraction is due to spasm of the cremaster muscle; the testicle is usually drawn up to the external abdominal ring, rarely within the inguinal canal, and it is stated that the testicle may even be retracted within the belly. When the retraction is constant and long-continued, the scrotum shrinks and the cord shortens, and adhesions may fix the testicle in its new position. When thus displaced, the testicle is exposed to injury and liable to attacks of inflammation, and possibly it may fail to secrete spermatozoa. When due to renal disease, the retraction occurs on the same side only; in other cases it is often bilateral.

Symptoms and Diagnosis.—The testicle is easily recognised in its new position by its size, shape, peculiar sensibility, and its absence from the scrotum. Its exposure to injury, and the pressure of the thigh upon it in walking and sitting make it a source of pain and annoyance to the patient. The only condition from which it has to be diagnosed is an imperfectly descended testicle; usually the history of the case clears up this point. When, however,

the history is not decisive, the surgeon must carefully notice the condition of the scrotum and the possibility of replacing the testicle in it. When the scrotum on the same side is fairly developed, although empty, and by moderate traction the testicle can be replaced in it, the case is one of retention rather than of non-descent. The occurrence of hernia, which is common in retained testicle, is a mere accidental association with retraction.

Treatment.—When due to renal disease or renal colic, the local irritation must, if possible, be removed, and heat and narcotics are to be used as palliatives. In other cases, all sources of urethral irritation—phimosis, gleet, sexual excess—must, if present, be remedied. Where no such cause of the affection exists, the testicle should be gently manipulated into its proper position several times a day, and, when a pad can be fitted over the inguinal ring above it, a light truss should be worn; cold douches are also recommended; gentle friction over the testicle with ung. belladonnæ has been found useful. Perseverance with these measures is usually successful, when treatment has not been delayed too long.

A. PEARCE GOULD.

TETANUS.—A condition of tonic spasm, in some cases limited to definite groups of muscles, in others affecting almost all the muscles with striated fibres in the body.

A distinction between idiopathic and traumatic tetanus has been very generally accepted, but does not appear to be of any practical importance. When the disease occurs in persons previously in good health, and without any injury, wound, or lesion, it is said to be idiopathic; but when it supervenes in the course of some other ailment, and after any lesion, however trivial, it is regarded as traumatic. The idiopathic form is very seldom met with in this country, but in tropical climates occurs more frequently. Exposure to damp and cold is believed to be a predetermining influence; but as this is also eminently conducive to the development of traumatic tetanus, and as this variety has, according to recorded cases, resulted from most insignificant injuries, such as the sting of a bee, the peck of a sparrow, or the too close paring of a finger nail, the distinction appears to be unnecessary.

Names have been devised to denote forms of tetanus in which definite groups of muscles have been especially attacked. When the muscles of mastication are solely

or chiefly affected, the condition is known as *trismus*. The term is etymologically incorrect, as it is applicable to the grinding and gnashing of the teeth in convulsions, rather than to the tonic spasm of tetanus.

Opisthotonos denotes the predominant contraction of the muscles of the back and neck, by which the body is arched with the convexity forwards. *Emprosthotonos* and *pleurosthotonos* are used to denote respectively curvature of the body with the convexity backwards or to one side. *Orthotonos* signifies the flat and rigid position of the body, when the anterior and posterior muscles are alike and equally contracted. These words are very useless practically, and it is very doubtful whether the forms of the disease denoted by the terms *emprosthotonos* and *pleurosthotonos* ever occur.

Some confusion may also be caused by the usurpation of late years by physiologists of the word tetanus to denote the normal contraction of striated muscular fibre, with the exception of that of the heart.

Tetanus has also been classified as *acute* and *chronic*; but, as time is the only test, the distinction is of no use to a surgeon who may be consulted at the commencement of the affection.

Practical surgery has to deal with traumatic tetanus occurring after wounds or injuries, maliciously or accidentally inflicted, or after operations. The liability to tetanus has no relation to the severity of the injury. It has occurred after the extraction of a tooth or the ligature of a pile, as well as after the amputation of a limb or the ligature of a large artery in its continuity. The popular belief, that wounds of the hands or fingers are especially liable to result in tetanus, is not corroborated by the evidence of statistics.

There are no definite premonitory symptoms. Usually the first indication is that the patient, who has previously been progressing favourably, awakens from sleep in the morning, in many cases for the last time in this world, with a sensation of stiffness in the muscles of the sides and back of the neck, by which movement of the head is rendered painful or inconvenient. The patient generally regards it as 'stiff neck,' caused by exposure to a draught of cold air. It is sometimes so slight as not to excite complaint or even notice from the patient, and is only discovered by the surgeon on examination and inquiry, when his attention has been directed to the nature of the case by other symptoms. The muscles of the face and lower jaw are next attacked. If the contraction of the orbicularis oris

muscle predominates, the lips will be closely pressed together; more usually they are drawn asunder, so as to produce the 'risus sardonicus' by the action of the elevators and depressors of the lips. The elevators of the lower jaw are constantly and characteristically contracted. Of these, the masseters are most accessible to observation, and feel like rigid, unyielding bands. They are sometimes sensitive on pressure. The contraction is not at first complete, and the patient can voluntarily increase it so as to press the jaws more closely together, and can then relax this increased contraction, but he is unable to overcome the tonic spasm.

As the disease progresses, the contraction usually becomes complete, and justifies the popular appellation of 'lockjaw.' The muscles of the fauces and pharynx are very frequently spasmodically contracted, so that the patient complains of sore-throat, and deglutition is either difficult or impossible. The muscles of the trunk are next involved. The walls of the thorax are immovable, and the respiration is shallow and frequent. Pain is felt at the pit of the stomach, from spasm of the diaphragm. The abdomen is flat and unyielding, from spasm of the abdominal muscles; and opisthotonos frequently results from predominant contraction of the muscles of the back and neck. When the lower extremities are affected they are rigidly extended, and the feet are strongly flexed. The upper extremities may also become rigid, but the muscles which move the fingers frequently, or, according to some observers, always, are not affected. The pulse is frequent and feeble, and the skin is bathed in profuse perspiration. If the temperature be previously normal, it will not be raised in this stage of the disease; but if, from other conditions, it be abnormally high, the onset of tetanus will not cause it to fall. There is usually constipation, partly from spasm of the sphincters of the bowel, and partly from the condition of the abdominal muscles. The profuse perspiration, and the inability in many cases to swallow fluids, will naturally diminish the excretion of urine, but there may be retention of this diminished quantity, from spasm of the compressor urethræ and abdominal muscles. Examination should therefore always be made of the condition of the bladder, and a catheter, if necessary, be introduced.

There is no cerebral symptom. The patient continues intelligent throughout the course of the disease, and not infrequently complains of hunger, and deplores his in-

ability to swallow. In many cases, death ensues at this stage from failure of the heart or from respiratory spasm. If not, symptoms of greatly increased reflex excitability appear. Violent convulsive exacerbations are produced by the lightest touch, or even by a current of air or a sudden noise. In these convulsions the tongue may be bitten or muscles ruptured. Sometimes, even bones have been fractured and dislocations produced. In this stage the temperature rises very considerably, and if death now ensues, the temperature has been found to increase appreciably for some time after death. If the patient still survive, these exacerbations may diminish in force and frequency, and at last cease altogether. The tonic spasm, which has hitherto been persistent, then begins to yield, and finally disappears. But so long as any trace of it continues, the patient is in great danger of a relapse. In many cases, however, death occurs from respiratory spasm during a convulsive attack. Sleeplessness is a characteristic feature in tetanus. If sleep can be induced by narcotics the tonic spasm is said to relax, and to instantaneously reappear when the patient awakes.

This is a general description of typical tetanus, but in individual cases there may be many variations. In infants, the spasm is usually limited to the elevators of the lower jaw, and thus constitutes the trismus neonatorum, popularly called 'nine-day fits,' from the time after birth at which the disease generally commences. In adults trismus alone is rare; it is usually associated with more or less contraction of the muscles of the neck and trunk. The extremities are sometimes not affected, and in some cases deglutition is only slightly, or not at all, impaired.

The *prognosis* in tetanus is always unfavourable. The mortality is less in idiopathic than in traumatic cases. But in each individual case, at the outset, the surgeon must, while endeavouring to prevent, yet expect a fatal result. In traumatic cases, the shorter the interval between the primary lesion and the appearance of tetanus, the more probably will death result. The duration of the disease is a very important element. Hippocrates observed that survival beyond the fourth day was a very favourable indication, and this has been corroborated by more modern experience. Death has, however, occurred thirty-nine days after the commencement of the attack. No correct inference can be formed from the apparent mildness of the symptoms. The writer had under his charge three cases of tetanus

in the year 1884, which all ended fatally, although the symptoms in each case were not severe.

The *diagnosis* does not present any difficulty. Sometimes inability to open the mouth, from some local inflammation, has been mistaken for trismus. In doubtful cases, a finger should be introduced between the teeth and cheek and the condition of the jaws explored; or, if necessary, an anæsthetic should be administered, and the cavity of the mouth and fauces examined. The existence of cerebral symptoms, which are always absent in tetanus, will sufficiently distinguish cerebro-spinal meningitis. Hydrophobia, in some respects, greatly resembles tetanus. The absence of trismus, and the complete intermissions between the convulsions, will prevent any doubt as to the nature of the case. The same distinctions apply to the tetanic convulsions produced by poisonous doses of strychnia. Hysterical trismus may be distinguished by the history of the patient and by the progress of the case.

The *treatment* of tetanus is very unsatisfactory. It happens so infrequently in civil practice that the experience of any individual surgeon is necessarily limited. The literature of the subject is abundant, but as it includes cases which were certainly not tetanus, the statistics as to results of treatment are not of much value. In traumatic tetanus the wound or injury should be thoroughly explored, so as, if possible, to remove any source of peripheral irritation. The patient should be isolated, and complete quietude maintained. If deglutition be possible, easily assimilable nutriment, alcohol, and sedatives, of which chloral hydrate is perhaps the best, should be freely administered. If deglutition be impossible, rectal injections may be tried. But if these prove impracticable, then brandy and narcotics may be injected hypodermically. In the three cases above referred to, which have been recently under the writer's charge, calabar bean was tried with the first; this apparently relieved the respiratory spasm, but death ensued within twenty-four hours. To the second case bromide of potassium was given in large doses. The pharyngeal spasm relaxed so that the patient could swallow fluids, but death occurred on the third day. In the third case, commencing convulsions of the muscles of mastication yielded to large and repeated doses of chloral hydrate, and the patient felt generally relieved, but death occurred on the third day.

Cold baths were formerly advocated, but are no longer used. The result in one

instance is worthy of notice. The patient was, at his own request, immersed in cold water. All symptoms at once ceased. He was instantaneously removed from the bath, but he was dead. Warm baths have been tried, but there are obvious difficulties in using them for cases of general tetanus, and the result, when they have been employed, is not encouraging. The constant application of ice to the spine, by means of Chapman's bags, has not proved of much benefit. Nicotine has been successfully used in some cases, but has failed in others. If tried, it should be given in doses of from one to two drops every two hours, and the effect on the action of the heart carefully observed. According to recorded cases, almost every drug in the Pharmacopœia has been tried without success. If benefit resulted in one or two cases, the hopes thus excited were soon disappointed by failure in other cases. Much was once expected from curare, but experience has not confirmed the expectations. Electro-therapeutics may possibly prove serviceable when our knowledge has been enlarged by greater experience in their application. Nerve-section and nerve-stretching have been also tried, but with disappointing results. In a few cases amputation has been successful, but this measure should only be adopted when there is distinct evidence of peripheral irritation from some otherwise irremediable cause, such as an irreducible dislocation.

The *pathology* of tetanus is very obscure. The considerable diminution in the number of cases of trismus neonatorum in the Dublin Lying-in Hospital when improved hygienic conditions were established, the experience of army surgeons in time of war, and the occurrence of so-called idiopathic tetanus, seem to prove clearly that unhealthy surrounding conditions may cause this disease. It is possible that under such conditions some poison may be engendered in, or absorbed by, the system, which may act specifically on the medulla oblongata and spinal cord. On the other hand, the great numerical preponderance of cases of traumatic tetanus, and the few cases where relief has resulted from the removal of some peripheral irritation, seem to indicate that some as yet unknown condition of a peripheral nerve may be the exciting cause. But it is inexplicable why one patient, for whom a pile may have been ligatured, should develop tetanus, while thousands of other patients, treated in a similar manner, should be free from such a result; or, why the injury of a peripheral nerve should primarily affect the centres of the fifth,

seventh, and eleventh cranial nerves. In a few cases the characteristic spasm has commenced in the muscles at the seat of injury. But this is a very rare and exceptional event. Post-mortem examinations have not advanced our knowledge of the subject. Macroscopically, congestion of the thoracic viscera, of the cerebro-spinal membranes, and of the grey matter of the brain and spinal cord, is discovered in all cases. Sometimes, portions of the spinal cord are soft or even diffuent. Microscopically, localised degeneration in both the grey and white substances of the brain and spinal cord, and granular exudations have been found in some cases. These are, however, probably only secondary results of some as yet unknown primary condition.

JEREMIAH MCCARTHY.

THECAL ABSCESS. See WHITLOW.

THERMO-CAUTERY. See CAUTERY.

THIGH, Amputation of the.—The alleged merits as well as defects of the 'circular' and 'flap' methods of amputation are more conspicuous in this group of operations than in any other, the advocates and opponents of each of the procedures alluded to having urged their arguments chiefly in reference to thigh amputations.

The advocates for the old, and what may be termed the classical, method—the *circular*—maintain that there is diminished risk to the patient, from the shock of the operation being less, that the area of the wound is necessarily not so great in extent, and that there is less danger, owing to the way the vessels are divided, of phlebotic inflammation. The supporters of flap operations, on the other hand, hold that there is less danger of a conical stump resulting, greater facility in getting sufficient covering for the bone, greater shapeliness of stump, and one better adapted for the subsequent adjustment of prosthetic mechanical appliances. Again, the cicatrix not being on the face of the stump, the inconvenience and pain to the patient produced by pressure on it are avoided. In order to secure a more ample covering than at times is obtained by the ordinary circular method, the modification of Syme already discussed in speaking of amputations of the leg is to be recommended—making, namely, an incision involving skin, fat, and fascia only, somewhat lunated in form, both on the anterior as well as posterior aspects of the limb, and combining that with circular division of the muscles.

The principles to follow in performing thigh amputations by the ordinary circular method, differ in no respect from those already indicated in describing amputation of the arm, and the other amputations in which the circular method is applicable.

Teale's rectangular method is, in the writer's opinion, specially applicable to thigh amputation, more particularly in its lower third. The measurements to be taken previously to the operation are: first, the circumference of the limb. Half of this will correspond to the length of the anterior flap as well as to its width, and one-fourth of the length of the anterior flap, or one-eighth of the circumference, will give that of the posterior flap. In making these rectangular flaps, care should be taken that the incisions in the first instance should not involve more than the integument, fat, and fascia. On making the deeper incisions, the divided edge of the integument, which has to a certain extent contracted and retracted, should be accurately followed. If this precaution be not taken, it will be found on adjusting the flaps that there will be considerable bulging or protrusion of the muscular tissues through the edges of the wound, which may materially interfere with a prompt and satisfactory union of it. The advantages of the operation are that the cicatrix is well drawn up behind; that all fluids which may accumulate find a ready exit from the wound, when the flaps are adjusted, being on the posterior aspect of the limb; that the flaps afford an ample covering for the bone; that there is diminished danger of the formation of a conical stump, and that the principal nerves and vessels, being for the most part in the posterior flap, are removed from the effects of pressure. The modifications of Sir Joseph Lister and Mr. Wharton have been already discussed. See AMPUTATIONS.

The other *flap amputations* of the thigh deserving of notice are Sédillot's, by a long anterior and no posterior flap; Spence's, which is analogous if not identical with that of O'Halloran and Benjamin Bell, and in which there are a long anterior oval and a short posterior flap. The length of the flap in Spence's operation should equal the diameter of the limb, and the breadth of its base be one half of the circumference. According to Sédillot, the breadth of the base should be even more. Care should be taken to avoid having the flaps too thick, which can be accomplished by oblique division of the muscles. Luke's amputation is done by antero-posterior flaps of equal length. In order to obtain this

with accuracy, he recommended the posterior flap to be made in the first instance, and subsequently on its retracting—which the posterior tissues do to a greater extent than the anterior—to form the anterior, making it of the same length as the posterior after its retraction. When the two flaps are brought together they should remain in accurate apposition, and the chances of a gaping wound subsequently occurring from the retraction above alluded to are largely diminished. Both flaps are made by transfixion.

A bilateral-flap method has been recommended by Vermales, both flaps being made by transfixion, and a somewhat similar method has been proposed by Von Langenbeck. In the latter procedure, however, the flaps are cut from without inwards. In both operations there is the danger of bone-protrusion, from the tendency of it to be tilted forwards through the wound. In consequence, neither operation finds, as a rule, much favour with operating surgeons.

For the control of hæmorrhage during the operation, Esmarch's elastic bandage will, in the great majority of cases, be found the most efficient method to employ. Elevation of the limb for a short time previously to the application of the bandage is to be recommended, as it removes or diminishes the necessity for any very firm pressure of the elastic bandage, which is to be avoided.

As regards the mortality of thigh amputation, there is no operation of the kind, excepting, perhaps, amputation at the hip-joint, which illustrates so signally the benefits that are to be derived from the employment of strict antiseptic precautions during and subsequent to the operation. Formerly, at no very remote date, septic complications played the main rôle in producing a mortality so high—upwards of 60 per cent.—as to justify the gravest apprehensions on the part of the operator. Now, however, when a rigid system of Listerian asepticism is employed, the surgeon can, in the great majority of instances, undertake the operation with a pleasing confidence as to a satisfactory result being obtained, which was wholly unknown to the surgeons of the pre-aseptic era.

Although some surgical operators of intelligence and experience are of opinion that the shock is greater after 'flap' than 'circular' amputations, and that, therefore, the latter method should be selected when the patient is in early childhood, or in cases of extreme debility or exhaustion from protracted suffering, hæmorrhage, or long-

continued profuse suppuration, still the writer's experience fails to afford him evidence that there is any solid foundation or reason for holding such a view. On the contrary, he is disposed to think that, in connection with amputation of the thigh especially, the 'flap' methods, notably those of Teale, Sédillot, or Spence, or, if the case will admit of a low femoral section, the 'supra-condyloid' method, are not attended with greater shock than the 'circular' or any of its modifications. See KNEE-JOINT, Amputations at the. They have, among other merits, the undoubted one of resulting in greater shapeliness of stump, with the cicatrix on its posterior aspect and thus relieved from the trouble that often attends pressure on it, and in every way better suited to the subsequent adaptation of mechanical appliances.

WILLIAM STOKES.

THIGH AND LEG, Diagnosis of Affections of the.—For the diagnosis of affections of the lower extremity it is of great importance to carefully compare the two limbs. Measurement from the anterior superior iliac spines to the internal or external malleolus can only be relied on as correct, when the spines are at the same level, and the limbs are placed in a symmetrical position as regards a vertical line through the umbilicus and symphysis pubis. If any swelling of the limb causes a deviation of the tape, a T square should be employed.

It is often necessary to ascertain the respective lengths of the femur and tibia. The most prominent point of the internal condyle of the femur and the inner articular edge of the tuberosity of the tibia should be marked, previously to taking the measurement. For the diagnostic importance of the relative positions of the trochanter and the head of the femur, reference must be made to HIP-DISEASE.

The diagnosis of a *femoral hernia* ordinarily presents no difficulty, and the position of its neck below Poupart's ligament and external to the pubic spine will at once distinguish it from an inguinal hernia. An irreducible omental femoral hernia, especially if the omentum be inflamed, is, however, often difficult to distinguish from a glandular swelling in the crural region. Impulse on coughing, and some variation in the size of the swelling on manipulation, together with the history of the case, will usually determine its nature. When strangulation exists, the seat of greatest tenderness will be at the neck of the sac, and not

over the general body of the swelling, as in an inflamed gland; but a most careful examination is necessary, and sometimes an exploratory incision will alone clear up the diagnosis. See GROIN.

An inflammatory enlargement of a *gland* or glands in the crural region sometimes occurs without any manifest cause.

An *acute abscess* in the upper part of the thigh presents no special difficulty in its recognition; but a chronic fluctuating swelling, or one that has appeared suddenly, unattended by active inflammatory symptoms, must be examined with special reference to its possible abdominal origin.

A *psoas abscess* often presents on the inner side of the thigh, at a lower point than a femoral hernia. There is an impulse on coughing, and the swelling is less tense when the legs are raised. An examination with the abdominal walls relaxed will generally discover a fluctuating swelling above Poupart's ligament, communicating with that in the thigh by a prolongation, which is first external to and then behind the femoral vessels. Such an abscess generally arises from vertebral caries, and a most careful examination of the back must be made before eliminating vertebral disease as a cause. See PSOAS ABSCESS.

An *abscess* situated just below the outer part of Poupart's ligament, which communicates with a swelling in the *iliac* region, may depend on hip-disease or pelvic bone mischief, or may have descended into the thigh from the abdomen, and be an extension of a subperitoneal or subfascial iliac abscess. The kidney, cæcal region, and pelvic organs must be examined. As an exceptional condition, an empyema may travel downwards and present in this situation.

A gaseous or *tympanitic abscess* is occasionally met with in the upper part of the thigh, and is either in connection with a femoral hernia; or the abscess has descended into the thigh from above Poupart's ligament, and is in close connection with bowel at its origin.

A fluctuating rounded swelling situated deeply in the groin under the psoas tendon, without impulse, and with entire absence of hip-symptoms, except perhaps some discomfort on extending the leg, is very likely to be a distension of the normal *bursa* in that situation. Occasionally, the communication with the joint is open, and the bursal contents can be partially emptied into the joint.

A chronic fluctuating swelling on the outer side of the thigh over the great tro-

chanter may be an *abscess*, or a distended condition of the multilocular *bursa* under the insertion of the gluteus maximus. In the latter case pressure will often permit of small seed-like bodies being felt, and the displacement of the fluid gives a peculiar and characteristic sensation to the fingers. An abscess in this situation may depend on hip-disease, or on disease of the trochanter, or be a chronic subfascial suppuration. A gluteal abscess not infrequently presents at the back part of the thigh near the trochanter, and may therefore be in connection with pelvic or vertebral bone-affection. See GLUTEAL REGION.

Acute bone-inflammation near the articular ends of the femur is not uncommon in young subjects. The fever and general constitutional disturbance are well-marked, and there are pain and tenderness on pressure over the part of the bone affected. Rapid inflammatory infiltration of the soft parts and formation of abscess occur. Deep abscess in the front of the lower part of the thigh, when acute may, however, be secondary to suppuration of the knee-joint, the pus having perforated the upper synovial pouch, and become diffused under the muscles. Pressure over the abscess would then probably cause the joint to refill.

Where the femoral artery is superficially placed, an *aneurismal dilatation* will readily be recognised. Any fluid or soft swelling placed over the femoral would not possess the characteristic expansile pulsation. A pulsating soft sarcoma of bone might push the artery forwards, and diminish by pressure the pulse in the vessels at the ankle. The swelling, however, would have fixed deep connections, and the bone would be felt to be enlarged. No alteration in the size or tension of the swelling would be noticed, when pressure was made on the vessel above or below its apparent expansion. The appearance of similar pulsating tumours in other parts would of course greatly simplify the diagnosis. A glandular or other non-pulsating tumour, placed over or surrounding the artery, would not be so likely to be taken for an aneurism, since expansile pulsation and bruit would be absent or ill-defined.

An aneurism in *Hunter's canal*, which had undergone consolidation, might easily, with a hasty examination and an absence of correct history, be mistaken for a tumour.

It is frequently difficult to determine the nature of a deep-seated soft swelling in the thigh. Care must be taken, in testing for fluctuation, to apply the fingers in the direction of the muscular fibres, and not across

them. A soft tumour, especially a *fatty* one deeply placed, will sometimes deceive the most experienced surgeon, and an exploratory puncture or incision will alone decide the question of the presence of fluid. If there be reason to suspect the presence of a *cavernous angioma*, circular pressure should be made round the upper part of the thigh, and the patient examined in the erect position; such a swelling would then become much more tense and prominent. The vasti and other muscles of the thigh may be affected by *syphilitic infiltrations*; in cases of doubt, the administration of iodide of potassium will often assist the diagnosis.

The lower end of the femur may be considerably enlarged by a central *necrosis*; as a rule sinuses are present, and there is a history of a previous inflammatory attack.

A *myeloid* tumour may cause great expansion of the bone, without any involvement of the cartilage or joint. At an early stage of its growth, such a tumour might be confounded with a chronic bone-abscess or some inflammatory enlargement, more especially as the patient in either case is usually young. A uniform expansion of the end of the bone, not attended by much pain or tenderness, and not interfering greatly with the movements of the joint, and with a recent history, will, in all probability, be a central sarcoma. Pulsation, if present, would make the probability greater; but the diagnosis must be made clear by a careful exploratory operation.

A *periosteal sarcoma* of the lower end of the femur does not end so abruptly as a central tumour; the growth, as a rule, more rapidly increases in size, and feels rather elastic than fluctuating. If the growth be very soft or cystic, fluctuation may be present; but an exploratory puncture will yield either blood or evidences of broken-down growth. Patients occasionally give a history of recent injury, and the swelling may at first simulate a blood-effusion or inflammatory thickening of the upper synovial pouch, but a very short observation of the progress of such a case will excite the surgeon's suspicions of its true character.

THE KNEE.—In any case of doubtful *fracture* near the knee, an examination under an anæsthetic should be made, and it should be ascertained if there be movement between the two condyles of the femur. A displacement at the knee will generally be found associated with a fracture of one of the condyles of the femur, or with an oblique fracture of the head of the tibia.

A recent displacement or fracture of the *patella* is, as a rule, sufficiently evident, but

if much swelling be present, or if the fragments remain in position, it might be overlooked. Pain on pressure over the bone would direct attention to the part. A careful comparison of the two knees must be made, any irregularity of the patella noticed, and the different parts of the bone tested for mobility and crepitus.

The condition of the quadriceps tendon and of the ligamentum patellæ must be determined. A *rupture* of either of these structures would occasion a considerable gap, which would be recognised by the finger. With a complete rupture of the ligamentum patellæ, the patella would be displaced upwards.

After a sprain of the knee some effusion into the joint may be expected, and tenderness and pain about the internal or external lateral ligaments. A displacement of one (usually the internal) of the *semilunar cartilages*, if unreduced, would give rise to a swelling corresponding to the margin of the cartilage, if the displacement be extra-articular; or to a depression, when, as more rarely happens, the cartilage is luxated inwards or centrally. Complete and free flexion and extension of the joint would only be possible when the displacement was reduced, and the patient would be conscious of the slipping of the cartilage back to its normal position, and of the relief at once afforded. The displacement is apt to recur on slight provocation, but is generally first caused by a severe and sudden strain. The impaction of a *loose body* between the articular surfaces occurs generally during the ordinary movements of the joint, and the patient is usually conscious that he has such a body moving about in his joint. It sometimes requires patient and repeated search by the surgeon before one of these movable bodies can be actually fixed under the finger. The distress and pain occasioned by the locking of the joint, from a foreign body getting between the bones, is often greater than that arising from a partial luxation of a semilunar cartilage.

Under ordinary circumstances, there is no difficulty in recognising an *effusion of fluid* into the knee-joint. Occasionally, some of the fluid can be pressed out of the joint into a hernial pouch or communicating bursa in the popliteal space. A pulpy thickening of the synovial membrane, from chronic inflammation or from gummatous infiltration, may give rise to a false sense of fluctuation; but the feeling of fluctuation is always indistinct, and limited to certain parts of the joint.

Periarticular swelling and joint-effusion can hardly be mistaken for one another, but occasionally the two conditions may be present; for example, after an injury there may be an effusion into the joint, associated with blood-extravasation around an inflammation of the prepatellar bursa, or peribursal suppuration.

A rounded fluctuating swelling situate above the patella, but with no fluid in the general cavity of the joint, is probably an effusion into the *suprapatellar bursa*. When there is no fluid in the knee-joint, and the ligamentum patella is prominent owing to a fluctuating swelling beneath it, and especially when the swelling is made more prominent on either side of the ligament by pressure on the same, an effusion into the *infrapatellar bursa* may be diagnosed.

The line of junction of the epiphyses at the knee is a favourite position for *exostoses*. They may be multiple, are usually pedunculated, and often have a small bursa over each of them. In cases of genu valgum and varum, an examination of the fascial and tendinous structures round the knee must be made. The leg should be fully flexed, in order to determine how much of the deformity depends on the articular ends of the femur or tibia, or both.

The examination of a knee-joint for *arthritis* must be conducted on the same general principles as in other joints, and a careful comparison made with the opposite leg. It is of great importance to examine the articular ends of the femur and tibia, and any enlargement or tenderness on superficial or deep pressure should be noted. In young subjects, the epiphysial junctions should receive special attention, and, in all cases, the size and position of the patella and the articular margins of the bones made out. The examination must be made in every position of the joint, and the mobility and effects produced by bringing different parts of the articulating surfaces into contact tested. In many cases, valuable information is obtained by relative measurement of the two limbs. Some elongation of femur or tibia is not infrequently present, when there has been a chronic inflammatory affection of their articular ends.

In all cases of progressive, destructive arthritis of the knee there is a tendency for the limb to assume a flexed position at the joint, and for the tibia to drop backwards and to be rotated somewhat outwards. See KNEE-JOINT, Diseases of the.

A *popliteal aneurism* can hardly be overlooked when the symptoms are at all marked, but the patient may not be conscious of any tumour behind the knee, and apply to the surgeon for some swelling of the foot, or for nerve-pain down the leg. Unless there be an obvious cause for such a condition, the surgeon should examine carefully the popliteal space, and more especially if the patient be a man from thirty to fifty years of age. See POPLITEAL ANEURISM.

When seen for the first time, and in the absence of a correct history, a *consolidated aneurism* might easily be mistaken for a solid tumour pressing on the artery and causing diminution of the pulse in the vessels in the leg. If the sac has inflamed, and suppuration takes place round it, the diagnosis in the absence of pulsation would be still more obscure. A solid or bursal tumour can generally, when the leg is flexed, be shifted away from the vessel, and any communicated pulsation will then at once cease. An abscess situated between the artery and the bone will displace the vessel towards the surface, but the pulsation will only be evident in the line of the artery, and expansile pulsation and bruit will be absent, and in most cases there would be evidence both constitutionally and locally of the presence of pus. A pulsatile sarcoma springing from the popliteal aspect of the femur might closely simulate an aneurism. A few of the points in the diagnosis of such a case have been mentioned in reference to femoral aneurism.

In the absence of any history of previous swelling, it might be difficult to distinguish between a sudden *rupture* of the popliteal artery and the traumatic rupture of an aneurism, since in both cases there would be great tension from effused blood and interference with the circulation of the leg. A rupture of the artery can only occur when the violence is considerable or the vessel diseased.

An effusion into the bursa between the semi-membranosus and the gastrocnemius can be recognised by its position on the inner side of the popliteal space. However tense such a swelling may be when the leg is extended, its limits can readily be felt when the leg is flexed. A communication with the joint can sometimes be demonstrated by squeezing some of the fluid out of the sac. See POPLITEAL SPACE.

THE LEG.—There are two *fractures* of the leg which are likely to be overlooked—namely, a transverse fracture of the tibia without displacement, and a fracture of the

fibula where the bone lies under cover of the muscles. The transverse fracture of the tibia generally occurs in a young subject. Tenderness over the seat of fracture is always present; the patient might be able to stand, but would have pain referred to the seat of injury. Mobility and crepitus would be difficult to elicit, unless the examination was made under an anæsthetic.

Not infrequently, the only evidence of a fracture of the fibula will be the fixed pain and tenderness over the seat of fracture, and pain referred to the same point when pressure is made on either end of the bone: the patient may be able to walk, but will complain of pain at the seat of fracture. Any irregularity of the bone must be carefully felt for, and the rebound of the fibula, when pressed against the tibia, tested by comparison with the sound leg.

If, during some muscular effort, a patient has felt a sudden severe pain in the calf and a sensation of something snapping, and on examination it is found that voluntary efforts to extend the foot give pain, and that there is some tenderness and ecchymosis of the calf, then, if the tendo Achillis be intact, the diagnosis of a *ruptured plantaris* may be made.

The upper end of the tibia is a common situation for *myeloid tumour*. The bone may, however, be considerably expanded by abscess, and, in some cases, the diagnosis can only be made by an exploratory operation. As the tibia is so superficially placed, acute and chronic bone-affections can for the most part be readily detected; but occasionally, when the disease is limited to the posterior part of the bone, the symptoms may be at first obscure.

In the *acute diffused periostitis* of the tibia of young persons, the inflammatory swelling and redness of the soft parts covering the bone somewhat resemble an erysipelatous attack; but the extreme tenderness on pressure, and the limitation of the redness and œdema to the shaft of the bone, render any mistake in the diagnosis almost impossible. See PERIOSTITIS.

Erythema nodosum on its first appearance occasionally simulates a circumscribed periostitis of the tibia. The affection is usually symmetrical, and sometimes to be found on the arms; but patches of erythema can generally be found away from the bone, and those situate over the bone are movable with the skin, and the general course of the affection is characteristic. See ERYTHEMA.

For the diagnosis of ulcers of the leg, see ULCERS. It must be remembered that a syphilitic ulcer may occur on the lower

part of the leg, and on a leg predisposed by the condition of the veins to simple ulceration. Rapid extension of an ulcer of the leg, without obvious cause (such as maltreatment), makes its syphilitic origin probable.

BERNARD PITTS.

THOMAS'S HIP-SPLINT consists of a piece of malleable iron, reaching from the lower angle of the scapula to just below the calf, and having three cross-pieces of the same metal attached to it. The first one is placed at the upper end of the splint and reaches partially round the chest, but more on the sound side than the other, being completed by a padded strap and buckle; the middle one is placed just below the nates, and the third one at the lower end of the splint. The vertical bar should lie between the trochanter and the tuber ischii, and below this over the middle line of the thigh or leg; the splint is supported by shoulder-straps, and is bandaged to the pelvis and to the limb between the lower two hoops; the foot is raised from the ground by a patten fitted to the boot of the sound leg, and the patient is taught to walk on that leg with the aid of crutches. The malleability of the splint allows of its being moulded to the shape of the limb, and of being altered as the deformity is rectified. See HIP-DISEASE.

It is, however, important that the splint be not made to fit the deformity accurately, for that would assist in maintaining it. In hip-joint disease, when the leg is brought straight down on to the bed, the lumbar spine arches forwards, and, if the splint were made to fit that arched condition of the spine, the deformity would be perpetuated. The portion of the splint which reaches from the buttock to the angle of the scapula should be nearly straight, for although it will not fit accurately when first applied, the spine will soon accommodate itself to the splint by gradual extension taking place at the hip-joint, and thus the deformity will be remedied.

BILTON POLLARD.

THOMAS'S KNEE-SPLINT is composed of two stout metal rods, which are fixed above to a well-padded and obliquely-placed ovoid ring, and below to a patten. When applied, the ovoid ring should rest against the tuber ischii on one side, and just below the crista ilii on the other, and the patten should be so far below the foot that, when the latter is extended, the toes cannot reach to the level of it. When the patient gets up, the splint is supported by a

strap over the opposite shoulder, and, when he walks on the splint, a patten must be fitted to the boot of the other foot in order to equalise the length of the limbs.

The success of this splint, as a means of fixing the knee, depends altogether on its being properly applied. Immobility of the limb must be secured in the longitudinal, lateral, and antero-posterior directions. Two strips of strapping, about three inches wide, and long enough to reach from the head of the tibia to twelve inches beyond the sole of the foot, should be prepared and fixed along each side of the leg; they should be secured by another strip, about an inch wide, wound spirally round the leg, and by a flannel bandage applied over all from the ankle to the knee. The splint should next be put on and pressed firmly upwards, so that the collar at the upper end rests against the tuber ischii, and then the free ends of the pieces of strapping above described should be fixed to the ring at the lower end of the splint; by this means longitudinal displacement is checked. Transverse and antero-posterior displacement must be prevented by applying transverse strips of strapping round the limb and the splint, opposite the middle of the thigh and the middle of the leg, in the following manner: A piece of strapping, about three inches wide, should be fixed round one of the lateral bars of the splint opposite the calf of the leg; the strapping should then be carried beneath the leg and round between it and the opposite longitudinal bar of the splint, and returned to the bar from which it started. It should next be carried beneath the limb to the opposite bar, round which it should be passed at a slightly higher or lower level than on its fellow; the strapping should finally be carried round the leg, between it and the bar from which the strapping originally started, and should be finished off by encircling the entire splint. The piece of strapping for the thigh should be applied in a similar manner, but it should start from the opposite bar. A third piece of strapping should be carried from bar to bar behind the limb, opposite the popliteal space; and a flannel bandage should be put on over all, from just above the ankle to the groin.

BILTON POLLARD.

THORACENTESIS. See PARACENTESIS THORACIS.

THORACIC DUCT, Injuries and Diseases of.—**INJURIES.**—Some six cases have been reported where the thoracic duct

has been divided by a stab or gun-shot wound, or has been ruptured by external violence. In three of these cases a white chylous fluid—which was whiter and more opaque after meals—escaped at an external wound. In one instance this fluid was effused into the pleural cavity, which had to be repeatedly tapped.

A diagnosis of the injury is impossible without evidence of chylous fluid either escaping from a wound or obtained from the pleural cavity by tapping. In every case death must follow (within a period of time measured by weeks rather than by months) from marasmus consequent upon the discharge.

The treatment is purely symptomatic.

DISEASES.—The duct may be narrowed or occluded as a result of inflammation of its coats, or the blocking of its lumen with cancerous or tubercular material, or by the pressure of an aneurism, tumour, or contracting cicatrices. The whole of the cavity of the duct has been in some cases obliterated. Complete obliteration need not cause death, nor even conspicuous symptoms. The veins appear in such instances to act vicariously, and it is probable that by means of collateral channels much lymph is brought into the right common duct. In a case of Dr. Cayley's the duct was occluded at its point of entry into the vein. It became in consequence enormously dilated, and, rupturing, led to fatal peritonitis. In other cases severe ascites has developed, or some of the lacteals have ruptured. The condition of the duct cannot be diagnosed during life.

The duct has been found enormously dilated as a result, in some cases, of obstruction, and in others as an outcome of unknown causes.

The wall of the duct has been found calcified. Its lumen may be occupied by tubercular or cancerous material derived from some focus of disease in the periphery. So far as the writer can ascertain, no instance of primary growth in the duct has been recorded. FREDERICK TREVES.

THROAT, Injuries of the.—*Wounds* of the throat are very serious: in the first place on account of the important structures which lie in this region; and in the second place because of the arrangement of the cervical fascia, which brings the deeper tracts into close relation with the cavity of the thorax. Many wounds are the result of suicidal attempts, and therefore have an additional element of danger in the depressed condition of the patient.

Those which are produced by accidental violence are most frequently of the punctured form, and they are usually accompanied by some contusion or laceration.

Below the hyoid bone, the cervical fascia divides the tissues into several compartments. In the first there are the superficial structures, together with the platysma myoides, and the vessels and nerves which lie outside the deep cervical fascia. Next, we come to a somewhat limited space, contained between this fascia and the aponeurosis which, after enveloping the depressors of the hyoid bone, terminates by reaching the posterior aspect of the sternum and clavicle. A small quantity of fat and a few lymphatic glands are contained in this space, which is also traversed by the anterior jugular vein. The third space lies between the aponeurosis of the depressors and the prevertebral fascia. The most important structures in it are the larynx and trachea, the pharynx and œsophagus, the thyroid body, the common carotid arteries and the internal jugular veins. The fourth and deepest stratum of all lies underneath the prevertebral fascia, and in close relation with the bodies of the cervical vertebræ.

Many wounds only affect the first or the first two of these compartments, and are usually of a trivial character. The external jugular vein, however, may be wounded, and death has occurred from the entrance of air into its cavity. Diffuse suppuration sometimes follows in the loose tissue beneath the platysma myoides, similar to that which occurs under the aponeurosis of the occipito-frontalis. The edges of the skin-wound are apt to be inverted from the contraction of the platysma fibres. Care should therefore be taken, after thoroughly cleansing the wound, to accurately adapt its edges by fine sutures, either interrupted or continuous, and provision should be made for the drainage of the deeper parts of the wound. The venous hæmorrhage may be arrested by pressure.

The great majority of wounds which affect the deeper parts are transverse in direction, and their most frequent situation is between the thyroid cartilage and the hyoid bone. It will be best to consider the dangers of these wounds and their treatment under the headings of the several structures which may be implicated.

The Blood-vessels.—The large vessels, and more especially the common carotid and internal jugular, frequently escape injury. Their immunity is due, first, to the fact that the incision is usually made so high that the knife is met by the resist-

ance of the cartilages in the middle line and the sterno-mastoids at the sides, before it reaches the deeply seated vessels; secondly, to the tough but yielding character of the vascular walls, which causes them to retreat before the knife; and lastly, to the fact that, as soon as the air-passages are opened, the air rushes out, the chest collapses, and the arms are in some measure disabled from continuing the suicidal attempt. A wound of one of these vessels usually proves fatal in a few minutes from loss of blood, or from the suffocation which follows its entrance into the air-passages. If the wound is high, the lingual and facial arteries, with their branches, may give rise to free hæmorrhage. Lower down, the superior thyroid is especially exposed to injury, and patients have been gradually asphyxiated from the trickling of blood into the trachea after division of the small crico-thyroid branch. Occasionally the inferior thyroid has also been wounded. The patient may for a time recover from the loss of blood immediately following the wound, but succumb afterwards to reactionary or secondary hæmorrhage. There is also more danger of air entering the veins in wounds of this region than in those of any other part of the body.

The Air-passages.—The chief immediate danger is from the entrance of blood, but in some cases the partial detachment of the soft parts or cartilages may cause obstruction to the glottis. Thus, when the wound is above the hyoid bone, the back of the tongue, with the epiglottis, may fall back upon the opening of the larynx. If the thyro-hyoid membrane be divided, portions of the epiglottis or arytenoid cartilages may occlude the rima, and, when the trachea is opened, there may be danger from the bulging in of the adjacent soft parts. The inflammation which follows the wound may cause swelling of the false vocal cords, and so impede respiration; or it may spread along the mucous membrane of the trachea and bronchi, so as to set up broncho-pneumonia. This, which is the most frequent cause of death, when the patients have survived the immediate effect of the injury, is aggravated, and in many cases originated, by foreign materials such as blood, particles of food, and inflammatory products which find their way into the air-passages. There may be temporary or permanent loss of voice from interference with the actions of the vocal cords.

The Food-passages.—If the pharynx or œsophagus be wounded, swallowing will be impeded or prevented; the food will es-

cape through the wound, or be extravasated into the adjacent tissues; or it may enter the air-passages, setting up violent fits of coughing, and leading to dangerous inflammation within the thorax. The food may also enter the air-passages even when the injury is confined to the larynx, on account of the disturbance produced in the muscular movements by which the opening of the glottis is protected during deglutition. When the wound is high up, large quantities of saliva may flow away, causing dryness of the fauces.

The Connective Tissues, Glands, &c.—

Air may be forced through the opening into the various compartments of the cervical fascia, and emphysema will be thus produced, which may spread to the face and thorax and even farther. This is especially likely to occur when the external opening is small, or not exactly opposite the wound of the air-passages. The tendency to this complication may also be increased by sewing up the wound in the skin. From the introduction of air, decomposing blood, or food, extensive suppuration frequently follows, and this may cause severe pressure upon the air and food passages, or it may run down into the mediastinum, and give rise to inflammation of the pleuræ and lungs. If the wound is high up in the neck, the salivary glands may be injured. Their secretion will flow from the wound, and a salivary cyst or fistula may ensue. If the wound is lower down, it may implicate the thyroid gland, and set up free hæmorrhage from its vascular parenchyma.

The Nerves.—The hypoglossal, the superior and inferior laryngeal nerves are liable to injury, and paralysis may consequently occur in the muscles of the tongue and larynx, or there may be some diminution of the sensitiveness of the laryngeal mucous membrane. Persistent aphonia may follow an injury to the inferior laryngeal nerve. It is possible also that the pneumogastric and phrenic nerves may be pressed upon in emphysema or suppuration of the deeper parts.

Treatment.—The first point is to stop the hæmorrhage, and to provide for the free ingress of air into the lungs. If any large vessel has been wounded, the finger must be introduced at once, and the bleeding point compressed. The patient should be laid upon his back in the horizontal position, and, after rapidly cleaning out the clots from the orifice of the glottis, it may be necessary to resort to artificial respiration until the patient is able to breathe

naturally. The head and neck should now be somewhat extended, so as to open the wound and enable the surgeon to find the source of hæmorrhage. When the internal jugular or one of the carotid vessels is wounded, it is desirable to apply a catgut or silk ligature both above and below the opening. All bleeding points should be secured, and the ends of the ligatures should be cut short, so as to leave nothing dangling from the wound which might be entangled in the dressings, or laid hold of by the patient, if he should persist in his suicidal attempts.

A careful examination should be made, to see whether any of the divided tissues are likely to interfere with respiration. Portions of the epiglottis or the other laryngeal cartilages may be secured in their places with sutures, and in the same way the posterior part of the tongue may be drawn forward. The divided edges of the trachea should also be accurately adapted with sutures. The patient should be placed in a warm moist atmosphere, and the same precautions adopted as after tracheotomy. In some cases it may be desirable to insert a tracheotomy tube through the opening, if it should be below the true vocal cords. In others, upon the supervention of dyspnoea or other symptoms indicating œdema glottidis, it may be necessary to perform laryngotomy or tracheotomy. Expectorants and the carbonate of ammonia will be required, should any evidence of bronchitis or pneumonia be detected.

If the œsophagus should be wounded it will be expedient to bring together the edges with chromicised catgut sutures. When either the air or food passages are implicated, food should be given by an œsophageal tube introduced through the mouth or nose. If this cause much disturbance it may be better to leave the tube in the œsophagus, or nutrient enemata may be given. The tube should not be introduced through the wound. Great care should be taken to ascertain that it has not entered the trachea. This would be indicated by the coughing it sets up, and by the current of air which would escape from the open end of the tube.

One or two sutures may be put in the extremities of the wound to lessen the gaping, and to prevent the inversion of the skin; but it is of great importance to leave the external wound open, so that any blood or food which may get into its deeper cavities may at once escape. With this object in view the approximation of the cutaneous margins should be procured by position

